### **CRC HANDBOOK**

of tables for

# ORGANIC COMPOUND IDENTIFICATION

Third Edition

Compiled by ZVI RAPPOPORT, Ph.D. Hebrew University of Jerusalem, Israel



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# First Edition Tables for Identification of Organic Compounds

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Second Edition
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Handbook of Tables for Organic Compound Identification

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#### **PREFACE**

The present volume is a revised and enlarged third edition of the book formerly titled TABLES FOR IDENTIFICATION OF ORGANIC COMPOUNDS. Four new classes of compounds, i.e., sulfonyl chlorides, sulfonamides, thiols and thioethers were added, bringing the number of classes included in the book to twenty-six. The tables of alkanes, alkenes, alkynes, aromatic hydrocarbons, phenols, nitriles and sulfonic acids were all thoroughly revised and considerably enlarged. In all, the addition of 2400 compounds to the third edition, raised the total number of parent compounds in the book to over 8150.

Three tables containing the dissociation constants of more than 1050 phenols, organic acids and organic bases were added. Correlation charts for I.R., Far I.R. and N.M.R. were also included.

Explanatory sections entitled "Explanations and References" precede the tables. In these sections the formulas of the derivatives and the full reaction equations for their preparation by the most important methods, together with some essential details and references to their preparations, are given.

An index covering both the names and synonyms of the compounds was added at the end of the book. An index listing the names of all tables and major subjects was also added.

The main objective of this book is to assist chemists in the identification of organic compounds. The organization of the compounds in classes according to increasing boiling points should also assist in the search for standard vapor phase chromatography work.

For further information of techniques of organic analysis one or more of the following books should be consulted:

- N. D. Cheronis, J. B. Entrikin and E. M. Hodnett, Semimicro Qualitative Organic Analysis, 3rd Ed., Interscience Publishers, New York, 1965.
- L. Meites, Handbook of Analytical Chemistry, McGraw Hill Book Co., 1963.
- F. Feigl, Spot Tests in Organic Analysis, 6th Ed., Elsevier Publishing Co., 1960.
- A. I. Vogel, A Textbook of Practical Organic Chemistry, 3rd Ed., Longmans Green and Co., London, 1957.
- R. L. Shriner, R. C. Fuson and D. Y. Curtin, *The Systematic Identification of Organic Compounds*, 4th Ed., John Wiley and Sons, New York, 1956.
- F. Wild, Characterization of Organic Compounds, 2nd Ed., Cambridge University Press, 1958.

The publication of the third edition would not have been possible without the work of those involved in the preparation of the earlier editions. The editor is thankful for the part in the earlier work contributed by Professors M. Frankel, S. Patai and A. Zilkha, and the late Mr. R. Farkas-Kadmon. Thanks are due also to Mrs. E. Shohamy and Mr. A. Glazer for assisting in collection of new data, to Mrs. Y. Elmaleh for typing the index, and especially to Prof. S. Patai, who as consulting editor, read all the new material and gave many helpful suggestions. The cooperation of Dr. Robert C. Weast and Mrs. F. Thomas in the publication of the book is gratefully acknowledged.

Z. R.

Jerusalem January 1967

#### **Contents**

Abbreviations

Explanations and References to the Tables

Alkanes and Cycloalkanes

Gases, Liquids, Solids

Alkenes, Cycloalkenes, Dienes and Polyenes

Liquids, Solids

Alkynes (Acetylenes)

Liquids, Solids

Aromatic Hydrocarbons

Liquids, Solids

Halides

- A) Alkyl and cycloalkyl halides
  - 1. Chlorides, Liquids and Solids
  - 2. Bromides, Liquids and Solids
  - 3. Iodides, Liquids and Solids
- B) Dihalides and polyhalides (non-aromatic)
  - 1. Fluorides
  - 2. Chlorides, Liquids and Solids
  - 3. Bromides, Liquids and Solids
  - 4. Iodides, Liquids and Solids
- C) Aryl halides
  - 1. Fluorides, Liquids
  - 2. Chlorides, Liquids and Solids
  - 3. Bromides, Liquids and Solids
  - 4. Iodides, Liquids and Solids

Alcohols

Liquids, Solids

Phenols

Liquids, Solids

Ethers

Liquids, Solids

Aldehydes

Liquids, Solids

Ketones

**Ouinones** 

Carboxylic Acids

Liquids, Solids

Acyl Halides

Acid Fluorides

Acyl Bromides, Liquids, Solids

Acyl Chlorides, Liquids, Solids

Acyl Iodides, Liquids, Solids

Acid Anhydrides

Liquids, Solids

Amides and Imides

Liquids, Solids

Esters

Liquids, Solids

### **Contents** (Continued)

Amino Acids

Amines

Primary and Secondary Amines

Tertiary Amines

Liquids, Solids

Carbohydrates

Liquids, Solids

Nitro Compounds

Liquids, Solids

Nitriles

Liquids, Solids

Sulfonic Acids

Sulfonyl Chlorides

Sulfonamides and Sulfonanilides

Thiols (Mercaptans)

Thioethers (Sulfides)

Acid Dissociation Constants of Organic Acids in Aqueous

Solution

Acid Dissociation Constants of Phenols in Aqueous

Solution

Dissociation Constants of Organic Bases in Aqueous

Solution

I.R.-Infra-red Correlations Charts

Far I.R.—Far Infra-red Vibrational Frequency Correlation

Charts

NMR-Characteristic NMR Spectral Positions for

Hydrogen in Organic Structures

Miscibility of Organic Solvent Pairs

Emergent Stem Correction for Liquid-in-Glass

Thermometers

Correction of Boiling Points to Standard Pressure

Molecular Elevation of the Boiling Point

Molecular Depression of the Freezing Point

Carbohydrates

Fats and Oils

Waxes

Diamagnetic Susceptibilities of Organic Compounds

Four-Place Logarithms

Periodic Table of the Elements

Table of Atomic Weights

Index of Organic Compounds

Index listing names of tables and major subjects

Request for New Data

#### LIST OF ABBREVIATIONS USED

far   b   specific rotation   glac   glacal   glacal   sabsolute   glac   glacal   glacal   sabsolute   glacal   glacal   glacal   sabsolute   glacal   glacal   glacal   sabsolute   glacal   glacal   glacal   sabsolute   glacal   glacal   gran   granular   racemace   racem			_			prisms
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deliq deliquescent dil dilute ord ordinary org organic var variable vic- vicinal oxid oxid oxidation visc viscous volat volatile or volatilizes efflor efflorescent et ethyl et ac ethyl acetate eth ether exp explodes f from fl flakes fluores fluorescent f p freezing point  ord ordinary org organic vic- vicinal visc viscous volat volatile or volatilizes vit violet w water exp wh white yet petroleum pet eth petroleum ether ph hydraz phenyl hydrazine pl plates  org organic vic- vicinal visc viscous volat volatile or volatilizes vit violet violet violet vic- viscous volat volatile or volatilizes vit violet vi			1		vac	vacuum, in vacuo
dist distillate  dk dark  dl , d,l, D,L racemic  efflor efflorescent  et ethyl  et ac ethyl acetate  eth ether  exp explodes  f from  fl flakes  fluores fluorescent  fp freezing point  dist distillate  org organic  ord oxidation  oxid oxidation  oxid oxidation  oxid oxidation  oxid vic-  vicinal  visc viscous  volatile or volatilizes  volt violet  w water  wh white  yet petroleum  pet eth petroleum ether  ph hydraz  phenyl  phenyl  phenyl  phenyl yelsh, ylsh  yellowish  shove, greater than  plates  plates  miscible  xyl  xyl  xyl  xyl  xyl  xyl  xyl  x	•	•	1 .	•	v	very
dk dark  dl , d,l, D,L racemic  efflor efflorescent  et ethyl  et ac ethyl acetate  eth ether  exp explodes  f from  fl flakes  fluores fluorescent  f p freezing point  dk dark  orth orthorhombic  oxid oxidation  oxid oxidation  oxid visc viscous  volat volatile or volatilizes  vit violet  w water  part partly  pet petroleum  pet eth petroleum ether  ph hydraz  phenyl  phenyl  phenyl  phenyl yelsh, ylsh  yellowish  > above, greater than  fluores fluorescent  pl plates  miscible  xvl xylene				<u>-</u>	var	variable
dl, d,l, D,L racemic efflor efflorescent et ethyl et ac ethyl acetate eth ether exp explodes f from fl flakes fluores fluorescent f p freezing point  dl, d,l, D,L racemic oxid oxidation p- para volat volatile or volatilizes volat volate volate volate volate volate volate volate volatile or volatilizes volat volate volatile or volatilizes volat volate			1 -		vic-	vicinal
efflor efflorescent et ethyl et ac ethyl acetate eth ether exp explodes f from flakes fluores fluorescent f p freezing point  p- para pale volat volatile or volatilizes vit violet w water wh white yet petroleum pet eth petroleum ether ph phenyl phenyl phenyl yelsh, ylsh yellowish > above, greater than plates  plates  p- para volat volatile or volatilizes vit violet w water yel yellow yelsh, ylsh yellowish > above, greater than plates  miscible			1		VISC	viscous
et ethyl et ac ethyl acetate eth ether exp explodes f from fl flakes fluores fluorescent f p freezing point  et ethyl pa pale part partly pet petroleum pet eth petroleum ether ph phenyl ph phenyl ph hydraz phenyl hydrazine ph plates ph plates ph plates pa pale vit violet w water wh white yel yellow yelsh, ylsh yellowish > above, greater than below, smaller than pl plates pounder  xyl xylene			1		volat	volatile or volatilizes
et ac ethyl acetate eth ether pet petroleum exp explodes f from ph phenyl yelsh, ylsh yellowish flakes ph hydraz phenyl hydrazine f p freezing point flakes plates f p freezing point flakes phenyl hydrazine f p freezing point flakes phenyl hydrazine plates partly w water wh white yel yellow yelsh, ylsh yellowish > above, greater than on miscible xvl xvl xvlene			11	•	vlt	violet
et ac ethyl acetate eth ether pet petroleum pet eth pet petroleum ether pet eth petroleum ether pet eth petroleum ether ph phenyl pheny		•	1 -	=		water
eth ether exp explodes f from phenyl yelsh, ylsh yellowish flakes fluores fluorescent f p freezing point  exp explodes pet eth petroleum ether ph phenyl yelsh, ylsh yellowish ph hydraz phenyl hydrazine ph hydraz phenyl hydrazine ph phenyl yelsh, ylsh yellowish ph hydraz phenyl hydrazine ph phenyl yelsow yelsh, ylsh yellowish ph hydraz phenyl hydrazine pl plates plates  miscible xyl xylene		•	1-		i .	white
f from ph phenyl yelsh, ylsh yellowish fl flakes ph hydraz phenyl hydrazine fluores fluorescent ph freezing point plates phenyl hydrazine plates phenyl hydrazine plates phenyl hydrazine phenyl hydrazine phenyl hydrazine phenyl hydrazine phenyl yelsh, ylsh yellowish  yelsh, ylsh yellowish  > above, greater than below, smaller than miscible			1 -			yellow
f from ph hydraz phenyl hydrazine shove, greater than ph hydraz phenyl hydrazine shove, greater than ph hydraz phenyl hydrazine shove, greater than shove, greater than ph hydraz phenyl hydrazine shove, greater than	•		1 ·	-	1 -	•
fluores fluorescent pluorescent pluorescent pluores plates pluorescent pluoresce					1	
f p freezing point plates $\infty$ miscible plates $\infty$ miscible representations of the plates $\infty$ miscible representations and the plates $\infty$ miscible representations of the plates $\infty$ miscible representations are provided as $\infty$ miscible representations.					<u>I</u>	
f p freezing point pi piaces xvl xvlene			-			
frz treezes powd powder powder			1 -	•	1	
	trz	1166268	1 powd	Po	, ,	

#### EXPLANATIONS AND REFERENCES TO THE TABLES

The following section gives explanations and references for the preparation of the derivatives appearing in the Tables Formulas of the derivatives as well as the main methods for their preparation are given Usually, only the reagents and the solvents required for the preparation of a derivative are mentioned without specific details for the reaction conditions and the exact procedure. The aim of these notes is mainly to enable the worker to choose the method preferable in the conditions and the reagents available to him in his laboratory for the derivatization of his specific compound. However, THIS IS ONLY A REFERENCE SECTION AND NOT AN INSTRUCTION MANUAL AND THE QUOTED REFERENCES SHOULD BE CONSULTED FOR THE ACTUAL PREPARATION OF DERIVATIVES, ESPECIALLY REGARDING SAFETY HAZARDS INVOLVED IN THE WORK.

References are usually given for the preparation of all the derivatives having separate columns in the Tables, as well as for important ones listed in the "miscellaneous" section of the Tables References to five different popular analytical textbooks are given, assuming that at least one of them, or another equivalent publication, would be available to the worker. These are

- N D Cheronis, J B Entrikin and E M Hodnett, Semimicro Qualitative Organic Analysis, 3rd edition, Interscience, New York, 1965, quoted in the text as "Cheronis"
- R P Linstead and B C L Weedon, A Guide to Qualitative Organic Chemical Analysis, Butterworth Scientific Publication, London, 1956, quoted in the text as "Linstead"
- R L Shriner, R C Fuson and D Y Curtin, The Systematic Identification of Organic Compounds, 4th edition, John Wiley and Sons, New York, 1956, quoted in the text as "Shriner"
- A 1 Vogel, A Textbook of Practical Organic Chemistry, 3rd edition, Longmans, Green and Co., London, 1957, quoted in the text as "Vogel"
- F Wild, Characterization of Organic Compounds, 2nd edition, Cambridge University Press, Cambridge, 1958, quoted in the text as "Wild"

In addition, leading references from the original literature are also given. Although the literature coverage is not complete (especially for the common derivatives) it was attempted to describe different methods, and to give as many references as possible to less common derivatives having limited scope. More references can be found in the textbooks mentioned above

Derivatives appear either in a separate column or in the "miscellaneous" section in the Tables, where separate columns are usually given for derivatives which should be tried first, and for which enough data are available. Derivatives which should be tried as a second choice, or preferred derivatives for which not enough data are available appear in the "miscellaneous" section. The explanations and the references for the different derivatives are arranged usually in the same order as in the Tables. Occasionally, this order is changed in the explanatory notes in order to describe the derivatives in a logical order (e.g., in Table 17 the phenylurethane appears in a separate column, while the phenylhydantoin appears in the "miscellaneous" section in the "explanations and references" section the phenylhydantoin appears directly after the phenylurethane)

Derivatives which are followed by an asterisk are those recommended for first trial. Other derivatives should be tried after these

Although "Ar" usually stands for monovalent aromatic group, we used it a few times in the following sections as a polyvalent aromatic residue. This was done only for demonstration purposes

#### **EXPLANATIONS AND REFERENCES TO TABLE I**

As a result of their inertness no general suitable derivative exists for alkanes and cycloalkanes. Characterization is based only on the physical constants given in the Table melting and boiling points, index of refraction and density. Any laboratory text-book will give adequate directions for the determination of these con-

stants		
WARNING	This is not an inci-	
	is included instruction manual	References should be consulted for the preparation of derivatives
		•

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#### **EXPLANATIONS AND REFERENCES TO TABLE I**

As a result of their inertness no general suitable derivative exists for alkanes and cycloalkanes. Characterization is based only on the physical constants given in the Table melting and boiling points, index of refraction and density. Any laboratory text-book will give adequate directions for the determination of these con-

stants		
WARNING	This is not an inci-	
	is included instruction manual	References should be consulted for the preparation of derivatives
		•

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### TABLE I. ALKANES AND CYCLOALKANES a) Gases and Liquids (Listed in order of increasing b.p.\*)\*\*

No	Name	<b>B</b> oiling point, °C	Melting point, °C	n 20	D <sub>4</sub> <sup>20</sup>
1	Methane	- 161 49	- 182 48 <sup>T</sup>		
2	Ethane	- 88 63	- 183 27 <sup>T</sup>		
3	Propane	-42 07	$-18769^{T}$	1	0 5005 <sup>8</sup>
4	Cyclopropane	- 32 86	- 127 42		0 720-79
5	2-Methylpropane (Isobutane)	- 11 73	- 159 6		0 5572 <sup>8</sup>
6	n-Butane	~0 50	- 138 35	1 3326 <sup>8</sup>	0 5788 <sup>s</sup>
7	2,2-Dimethylpropane (Neopentane)	9 503	-16 55	1 342 <sup>s</sup>	0 5910 <sup>8</sup>
8	Cyclobutane	13 08741, 12 5	-80	1 37520°	0 7038°
9	1,1-Dimethylcyclopropane	20 63	- 108 96	1 3668	0 6589
10	2-Methylbutane	27 852	- 159 9	1 35373	0 61967
	trans-1,2-Dimethylcyclopropane	29		1 3713	0 6769
12		35 94	- 149 41	1 3786	0 6839
	n-Pentane	36 074	-129 721	1 35748	0 62624
14	Methylcyclobutane	36 3	}	1 3830	0 6933
	cis-1,2-Dimethylcyclopropane	37	-140 9	1 3822	0 6928
16	Spiropentane	38 977	-107 06	1 41200	0 755
17	Cyclopentane	49 262	-93 879	1 40645	0 74538
	2,2-Dimethylbutane	49 741	-99 87	1 36876	0 64916
	1,1,2-Trimethylcyclopropane	56 7750	// //	1 384819 5	0 682219 5
	2,3-Dimethylbutane	57 988	-128 538	1 37495	0 66164
	2-Methylpentane	60 271	-128 536 -153 67	1 37145	0 65315
	,	63 282	15507	1	0 66431
	3-Methylpentane	65 7755		1 37652	0 694618
	1,2,3-Trimethylcyclopropane		- 95 348	1 394518	
_	n-Hexane	68 74		1 37486	0 65937
25	Ethylcyclobutane	70 64	-142 85	1 4020	0 7280
	Methylcyclopentane	71 812	- 142 455	1 4097	0 74864
	2,2-Dimethylpentane	79 197	-123 811	1 38215	0 67385
- 1	2,4-Dimethylpentane	80 5	-119 242	1 38145	0 67270
29	Cyclohexane	80 738	6 554	1 42623	0 77855
	2,2,3-Trimethylbutane	80 882	- 24 912	1 38944	0 69011
	3,3-Dimethylpentane	86 064	-134 46	1 39092	0 69327
	1,1-Dimethylcyclopentane	87 846	- 69 795	1 41356	0 75448
	2,3-Dimethylpentane	89 784		1 39196	0 69508
34	2-Methylhexane	90 052	-118 276	1 38485	0 67859
	trans-1,3-Dimethylcyclopentane	90 773	- 133 702	1 40894	0 74479
36	cis-1,3-Dimethylcyclopentane	91 725	- 133 975	1 41074	0 74880
37	3-Methylhexane	91 850		1 38864	0 68713
38	trans-1,2-Dimethylcyclopentane	91 869	-117 58	1 41200	0 75144
39	3-Ethylpentane	93 475	-118 604	1 39339	0 69816
40	Quadricyclane (Quadricyclo [2,2,1,02 6,03 5]	98		1 4804	1
	heptane)		1	ļ	
41	n-Heptane	98 427	-90 61	1 38764	0 68376
42	2,2,4-Trimethylpentane	99 238	-107 38	1 39145	0 69192
43	cis-1,2-Dimethylcyclopentane	99 532	-53 892	1 42217	0 77262
44	Methylcyclohexane	100 934	- 126 593	1 42312	0 76939
45	Ethylcyclopentane	103 466	- 138 446	1 41981	0 76647
	1,1,3-Trimethylcyclopentane	104 893	- 142 44	1 41119	0 74825
	2,2-Dimethylhexane	106 84	- 121 18	1 39349	0 69528
	2,5-Dimethylhexane	109 103	-91 20	1 39246	0 69354
1	1,trans-2,cis-4-Trimethylcyclopentane	109 29	- 130 78	1 41060	0 74727
	2,4-Dimethylhexane	109 429	1	1 39534	0 70036
	2,2,3-Trimethylpentane	109 841	- 112 27	1 40295	0 71602
	1,trans-2,cis-3-Trimethylcyclopentane	110 2	-112 705	1 4138	0 7535
	3,3-Dimethylhexane	111 969	-1261	1 40009	0 7100
	2,3,4-Trimethylpentane	113 467	-109 21	1 40422	0 71906
	1,1,2-Trimethylcyclopentane	113 729	-21 64	1 42298	0 77252
	2,3,3-Trimethylpentane	114 76	-100 70	1 40750	0 72619
	2,3-Dimethylhexane	115 607	100 /0	1 40113	0 71214
	3-Ethyl-2-methylpentane	115 65	-114 96	1 40401	0 71932
٥٥	3-Emyi-4-methythentane	113 03	] -114 70	1 40401	0 11752

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

<sup>\*\*</sup>T = triple point, S = at saturation pressure

# TABLE I. ALKANES AND CYCLOALKANES a) Gases and Liquids (Listed in order of increasing b.p.\*) (Continued)

0	Name	Boiling point, °C	Melting point, °C	n <sup>20</sup>	D40	
59	1,cis-2,trans-4-Trimethylcyclopentane	116 731	-132 55	1 41855	0 76345	
60	1,cis-2,trans-3-Trimethylcyclopentane	117 5	-112	1 4218	0 7704	
61	2-Methylheptane	117 647	- 109 04	1 39494	0 69792	
62	4-Methylheptane	117 709	- 120 955	1 39792	0 70463	
63	3,4-Dimethylhexane	117 725	j'	1 40406	0 71923	
64	1,cis-2,cis-4-Trimethylcyclopentane	118	1	1 422	0 766	
65	3-Ethyl-3-methylpentane	118 259	- 90 87	1 40775	0 72742	
- 1	3-Ethylhexane	118 534	1	1 40162	0 71358	
67	3-Methylheptane	118 925	-120 5	1 39848	0 70582	
	Cycloheptane (Suberane)	118 20	-7 98	1 4449	0 8275°	
	trans-1,4-Dimethylcyclohexane	119 351	- 36 962	1 42090	0 76255	
	1,1-Dimethylcyclohexane	119 543	- 33 495	1 42900	0 78094	
	cis-1,3-Dimethylcyclohexane	120 088	- 75 573	1 42294	0 76603	
	trans-1-Ethyl-3-methylcyclopentane	120 8	- 108	1 4186	0 7619	
- 1	trans-1-Ethyl-2-methylcyclopentane	121 2	ļ	1 4219	0 7690	
	cis-1-Ethyl-3-methylcyclopentane	121 4		1 4203	0 7724	
	1-Ethyl-1-methylcyclopentane	121 522	- 143 80	1 42718	0 78093	
- 1	2,2,4,4-Tetramethylpentane	122 284	- 66 54	1 40694	0 71947	
	1,cis-2,cis-3-Trimethylcyclopentane	123 0	-116 43	1 4262	0 7792	
- 1	trans-1,2-Dimethylcyclohexane	123 419	- 88 194	1 42695	0 77601	
	2,2,5-Trimethylhexane	124 084	- 105 78	1 39972	0 70721	
	cis-1,4-Dimethylcyclohexane	124 321	- 87 436	1 42966	0 78285	
	trans-1,3-Dimethylcyclohexane	124 45	- 90 108	1 43085	0 78472	
	n-Octane	125 665	- 56 795	1 39743	0 70252	
- 1	Isopropylcyclopentane	126 419	-111 375	1 42582	0 77653	
	2,2,4-Trimethylhexane	126 54	- 120	1 4033	0 7156	
	cis-1-Ethyl-2-methylcyclopentane	128 050	- 105 95	1 42933	0 78522	
- 1	cis-1,2-Dimethylcyclohexane	129 728	- 50 023	1 43596	0 79627	
	2,4,4-Trimethylhexane	130 38	-113 38	1 40745	0 72381	
	n-Propylcyclopentane	130 8	-1187	1 4266	0 7761	
	2,3,5-Trimethylhexane	131 34	- 127 8	1 4061	0 7219	
	Ethylcyclohexane	131 783	-111 323	1 43304	0 78792	
- 1	2,2-Dimethylheptane	132 69	-1130	1 4016	0 7105	
- 1	2,2,3,4-Tetramethylpentane	133 016	- 121 09	1 41472	0 73895	
	2,4-Dimethylheptane	133 5	)	1 4033	0 716	
	Methylcycloheptane	133 5		1 4410	0 8052	
	2,2,3-Trimethylhexane	133 6 133 8	}	1 4105	0 7292	
	4-Ethyl-2-methylhexane 3-Ethyl-2,2-dimethylpentane	133 83	-99 2	1 4068 1 4123	0 723	
- 1	• ,		-99 2	*	0 7348	
,	4,4-Dimethylheptane	135 2	102.0	1 4076	0 725	
	2,6-Dimethylheptane	135 21 136 0	- 102 9	1 4007	0 7089	
	2,5-Dimethylheptane 3,5-Dimethylheptane	136 0		1 4038 1 4067	0 715 0 723	
- 1	Bicyclo[4.2.0]octane	136 0	]	1 4067	0 723	
	cts-Bicyclo(3.3.0)octane	136-6 5		1 4513	0 8638 <sup>25</sup>	
- 1	2,4-Dimethyl-3-ethylpentane		122.2		0 7379	
	1,1,3-Trimethylcyclohexane	136 73 137–8	-122 2	1 4137 1 4362	0 7379 0 7868 <sup>25</sup>	
	3,3-Dimethylheptane	137-8	)	1 4362	0 7868**	
- 1	2,2,5,5-Tetramethylhexane	137 5	1	1 40550	0 71875	
	2,3,3-Trimethylhexane	137 68	-116 80	1 4141	0 738	
,	3-Ethyl-2-methylhexane	137 68	-110 00	1 4120	0 731	
- 1	trans-1,3,5-Trimethylcyclohexane	138 5-9754	1	1 42740 <sub>H</sub>	0 7720	
	2,3,4-Trimethylhexane	139 0	1	1 42/40 <sub>H</sub> 1 4144	0 7720	
1	cis-1,3,5-Trimethylcyclohexane	140-0 5752	}		0 7773	
١.	trans-1,2,4-Trimethylcyclohexane	140-1	1	1 43010 <sub>H</sub>	0 7813	
1	2,2,3,3-Tetramethylpentane	140-1	-99	1 43121 <sub>He</sub> 1 42360		
	4-Ethyl-3-methylhexane	140 274	-77	l l	0 75666 0 742	
	3,3,4-Trimethylhexane	140 46	-101 2	1 416 1 4178	0 742	
· • 1	Jest Trimern's HEAdile	17040	-101 2	171/0	0 /434	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### TABLE I. ALKANES AND CYCLOALKANES a) Gases and Liquids (Listed in order of increasing b.p.\*)(Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sup>20</sup>	D <sub>2</sub> º
			point, C		
118	3,4-Dimethylheptane	140 6		1 4111	0 7314
կ19	3-Ethyl-3-methylhexane	140 6		1 4142	0 741
	• •	141 2	100.100	1 4096	0 730
121	2,3,3,4-Tetramethylpentane	141 551	- 102 123	1 42222	0 75473
	2,3-Dimethyl-3-ethylpentane	142	1	1 419	0 754
123	trans-1,2,3-Trimethylcyclohexane	142 3 5762		1 43582 <sub>He</sub>	0 7914
	1-Isopropyl-3-methylcyclopentane (Pulegan)	142 4		1 4236	0 773022
125	4-Methyloctane	142 48	-1132	1 4061	0 7199
126	1-Isopropyl-2-methylcyclopentane	142 5759		1 4279	0 7792
127	3-Ethylheptane	143 0	20.4	1 4093	0 727
	•	143 26	- 80 4	1 4031	0 7134
129	cis-1,2,3-Trimethylcyclohexane	144-6753	100 /	1 43682 <sub>He</sub>	0 7930
	•	144 18	-107 6	1 4062	0 7207
	2,4,6-Trimethylheptane	144 8		1 4071	0 7225
	cis-1,2,4-Trimethylcyclohexane	146		1 43209	0 786
	3,3-Diethylpentane	146 168	-33 11	1 42051	0 75359
	2,2-Dimethyl-4-ethylhexane	147		1 4131	0 733
	2,2,4-Trimethylheptane	147 7		1 4092	0 7275
	2,2,4,5-Tetramethylhexane	147 8		1 41318	0 73546
	2,2,5-Trimethylheptane	148		1 409	0 726
	2,2,6-Trimethylheptane	148 2		1 4059	0 7195
	2,2,3,5-Tetramethylhexane	148 4		1 4142	0 7378
140	Nopinane (7,7-Dimethylbicyclo[3 1 1]heptane)	149747		1 4641	0 861122
	trans-1-Ethyl-4-methylcyclohexane	149 05- 15	-808	1 4304	0 7798
142	Cyclooctane	150750	14 (4 3)	1 4586	0 8349
	1-Ethyl-2-methylcyclohexane	150 2		1 432	0 784
144	n-Nonane	150 81	- 53 519	1 40542	0 71763
	1,3,3-Trimethylbicyclo[2.2.1]heptane (Fenchane)	151 2		1 44714	0 8345
	trans-1-Ethyl-4-methylcyclohexane	151 69		1 4382	0 7972
	cis-1,1,3,5-Tetramethylcyclohexane	152 4- 5		1 4319	0 7813
148	cis-1-Ethyl-4-methylcyclohexane	152 55 60		1 4374	0 7969
	2,5,5-Trimethylheptane	152 8		1 4136	0 7368
	2,4,4-Trimetbylheptane	153		1 412	0 733
	2,3,3,5-Tetramethylhexane	153		1 4196	0 746
	2,2,4,4-Tetramethylhexane	153 3		1 4208	0 7470
153	Isopropylcyclohexane	154 5	- 89 8	1 44095	0 80232
	1,1,3,3-Tetramethylcyclohexane	154 8-5 0	1	1 4374	0 7936
	2,2,3,4-Tetramethylhexane	154 9		1 4226	0 7548
	2,2-Dimethyloctane	155		1 4082	0 7245
	3-Ethyl-2,2,4-trimethylpentane	155 3		1 4223	0 7571
	3,3,5-Trimethylheptane	155 6		1 4170	0 7428
	2,3,6-Trimethylheptane	155 7		1 4125	0 7345
	2,4-Dimethyloctane	155 8 6 0		1 4090	0 725920
	d,l-cis-1-Ethyl-3-methylcyclohexane	155 97		1 4432	0 8094
	d,l-2,5-Dimethyloctane	156-8		1 4160	0 7370
	1,1,3,5-Tetramethylcyclohexane	156 4 5	107.005	1 4370	0 7929
	n-Butylcyclopentane	156 56	-107 985	1 4316	0 7846
	n-Propylcyclohexane	156 724	- 94 90	1 43705	0 79360
1	2,3,5-Trimethylheptane	157		1 416	0 741
	2,5-Dimethyl-3-ethylhexane	157		1 416	0 741
	2,4,5-Trimethylheptane	157		1 4160	0 741
	2,4-Dimethyl-3-isopropylpentane	157		1 42463	0 75830
	2,2,3-Trimethylheptane	158	]	1 417	0 7420
	2,4-Dimethyl-4-ethylhexane	158		1 419	0 747
	2,2-Dimethyl-3-ethylhexane	159		1 420	0 749
	2,2,3,4,4-Pentamethylpentane	159 3	1	1 43069	0 76703
	1,1,3,4-Tetramethylcyclohexane	159 5-6 1		1 4380	0 7976
	5-Ethyl-2-methylheptane	159 7		1 4134	0 736
176	2,7-Dimethyloctane	159 9	1	1 4086	0 7242

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# TABLE I. ALKANES AND CYCLOALKANES a) Gases and Liquids (Listed in order of increasing b.p.\*)(Continued)

No	Name	Boiling	Melting	D 20	Di	
	rant	point, °C	point, °C	n 20	D <sub>4</sub>	
177	3,6-Dimethyloctane	160		1 414518	0 7363	
	3,5-Dimethyloctane	160		1 413	0 736	
	4-Isopropylheptane	160		1 417	0 741	
180	2,3,3-Trimethylheptane	160		1 4202	0 7488	
181	4-Ethyl-2-methylheptane	160		1 413	0 736	
182	2,6-Dimethyloctane	160-0 5		1 4113	0 7285	
183	2,2,3,3-Tetramethylhexane	160 3		1 42818	0 76446	
184	trans-1-Isopropyl-4-methylcyclohexane	161		1 4393	0 792	
	(p-Menthane)	,				
185	4,4-Dimethyloctane	161		1 4144	0 7347	
186	2,3,4,5-Tetramethylhexane	161		1 424	0 757	
187	5-Ethyl-3-methylheptane	161		1 414	0 737	
	3,3-Dimethyloctane	161 2		1 4165	0 7390	
	4,5-Dimethyloctane	162		1 4173	0 7458	
	3,4-Diethylhexane	162		I 420	0 754	
	4-Propylheptane	162		1 4150	0 7364	
	1,1,4-Trimethylcycloheptane (Eucarvane)	162 3720		1 4420	0 8011	
	trans-1,2,3,5-Tetramethylcyclohexane	162 4		1 44657 <sub>He</sub>	0 8140	
	2,3,4,4-Tetramethylhexane	162 2		1 4270	0 7639	
	2,3,4-Trimethylheptane	163		1 421	0 751	
	3-Isopropyl-2-methylhexane	163		1 421	0 751	
	2,2,7-Trimethylbicyclo[2.2.1]heptane ( $\alpha$ -Fenchane)	163 5 4 5753		1 4590	0 8579	
	3-Ethyl-3-methylheptane	163 8		1 4208	0 7501	
	2,4-Dimethyl-3-ethylhexane	164		1 424	0 759	
	3,4,4-Trimethylheptane	164		1 424	0 757	
	3,3,4-Trimethylheptane	164		1 424	0 757	
	3,4,5-Trimethylheptane	164		1 424	0 759	
	2,3-Dimethyl-4-ethylhexane	164		1 424	0 759	
	1-Methyl-3-propylcyclohexane	164-5 (171-3)		1 4377	0 789521	
1	2,3-Dimethyloctane d,l-Pinane	164 4 4 6 <sup>764</sup>		1 4152	0 7377	
	2,3,3,4-Tetramethylhexane	164 5 5 0 164 6	1	1 4609	0 8551	
- 1	3,3-Dimethyl-4-ethylhexane	165		1 4297 1 427	0 7694 0 764	
·	5-Methylnonane	165 1	-877	1 427	0 7326	
- 1	4-Methylnonane	165 7	-987	1 4123	0 7323	
1	3-Ethyl-2-methylheptane	166	-767	1 4123	0 746	
1	3,4-Dimethyloctane	166		1 4182	0 746	
- 1	$d-\alpha$ -Pinane	166 6 5762		1 4630	0 8560	
	d,l-1-Isopropyl-3-methylcyclohexane	166 7		1 4424	0 796524	
-17	(d,l-m-Menthane)	100 /		, , , ,	Q 7903	
215	2,2,3,3,4-Pentamethylpentane	166 1		1 43606	0 78009	
	trans-1,2,4,5-Tetramethylcyclohexane	166 2-8 0		1 44446 <sub>He</sub>	0 8100	
	3,3-Diethylhexane	166 3		1 428	0 767	
	2-Methylnonane	166 8	<b>-74</b> 5	1 4099	0 7281	
,	d-1-Isopropyl-3-methylcyclohexane	167		1 446 23	0811623	
	(d-m-Menthane)				- 3.7-	
220	3-Ethyl-4-methylheptane	167		1 422	0 753	
	4-Ethyl-3-methylheptane	167		1 422	0 753	
	4-Ethyl-4-methylheptane	167		1 421	0 752	
	l-β-Pinane	167 5-8748		1 4605	0 8567	
- 1	3-Methylnonane	167 8	-848	1 4125	0 7334	
	3-Ethyloctane	168		1 416	0 740	
	4-Ethyloctane	168	ĺ	1 416	0 740	
	3-Ethyl-2,2,3-trimethylpentane	168	į	1 436	0 781	
	l-I-Isopropyl-3-methylcyclohexane (l-m-Menthane)	168		1 4358	0 7938	
	cis-1-Isopropyl-4-methylcyclohexane	168 5		1 4515	0 816	
/	(cis-p-Menthane)				-	
230	cis-1,2,3,5-Tetramethylcyclohexane	168-70762		1 44847 <sub>He</sub>	0 8166	
	2,3-Dimethyl-3-ethylhexane	169		1 427	0 765	

<sup>\*</sup>Derivative data given in order mp, crystal color solvent from which crystallized

# TABLE I. ALKANES AND CYCLOALKANES a) Gases and Liquids (Listed in order of increasing b.p.\*) (Continued)

No	Name		Boiling point, °C	n 20	D <sub>4</sub> <sup>20</sup>
232	1-Isopropyl-4-methylcyclohexane (p-Menthane)	169 70		1 437521	0 7929
233	3,4-Dimethyl-3-ethylhexane	170		1 431	0 772
	3,3,4,4-Tetramethylhexane	170		1 4368	0 7824
235	Cyclononane	170-2	97	1 432816	0 853415 2
236	1-Isopropyl-2-methylcyclohexane (o-Menthane)	171		1 44721	0 813521
237	cis-1,2,4,5-Tetramethylcyclohexane	171755	J	1 44647 <sub>He</sub>	0 8122
	1-Methyl-1-propylcyclohexane	172		1 4440	0 8101
239	n-Decane	174 123	- 29 661	1 41189	0 73005
240	1-Methyl-4-propylcyclohexane	174 3-7 1	[	1 4393	0 798
	1-Methyl-2-propylcyclohexane	175 5 6 07 6		1 446819	0 813019
	n-Pentylcyclopentane	180 6010	-83	1 4358	0 7912
243	n-Butylcyclohexane	180 947	<b>- 74 725</b>	1 44075	0 79918
244	trans-Decahydronaphthalene (trans-Decalin)	187 25	- 30 40	1 4695	0 8699
	Isoamylcyclohexane	193		1 4423	0 8023
	cis-Decahydronaphthalene (cis-Decalin)	195 69	-43 01	1 4810	0 8965
247	n-Undecane (n Hendecane)	195 89	- 25 594	1 41716	0 74017
	Cyclodecane	201	9 6	1 4692	0 857720 4
249	n-Pentylcyclohexane	202 8	- 57 5	1 4437	0 8037
250	n-Hexylcyclopentane	203		1 4392	0 7965
251	9-Methyl-trans-decahydronaphthalene	205, 7710		1 4631	0 8620
252	1,10-Dimethyl-trans-decahydronaphthalene	213 8310		1 4659	0 8633
253	9-Methyl-cis-decahydronaphthalene	215 8510		1 4804	0 8910
254	n-Dodecane	216 278, 51 841	-9 587 (-12)	1 42160	0 74869
255	1,10-Dimethyl-cis-decahydronaphthalene	220, 88 9910	, , ,	1 4812	0 8896
	n-Hexylcyclohexane	224 0, 92 010	-43	1 4462	0 8076
257	n-Heptylcyclopentane	224		1 4421	0 8010
258	9-Ethyl-trans-decahydronaphthalene	225 93 0610		1 466	0 8610
259	9-Ethyl-cis-decahydronaphthalene	233 9910		1 480	0 8860
260	1-Methyl-trans-decahydronaphthalene	235, 10110		1 4270	)
261	n-Tridecane	235 44 66 351	- 5 392	1 4256	0 7564
262	Bicyclohexyl	236 5 7 5, 10010	3 5~4 0	1 4795	0 8848
263	n-Octylcyclopentane	243		1 4446	0 8048
	n-Heptylcyclohexane	244		1 4484	0 8109
265	n-Tetradecane	235 57, 80 131	5 863	1 4289	0 7628
266	n-Nonylcyclopentane	262		1 4467	0 8081
267	n-Octylcyclohexane	264		1 4503	0 8138
	n-Pentadecane	270 63, 93 261	9 926	1 4319	0 7685
	n-Decylcyclopentane	279 3		1 44862	0 81097
	n-Nonylcyclohexane	282		1 4519	0 8163
	n-Undecylcyclopentane (n-Hendecylcyclopentane)	296		1 4503	0 8135
	n-Decylcyclohexane	299		1 45338	0 81858
	2-Methylheptadecane	311, 178 515		1 439414	0 783815
	n-Dodecylcyclopentane	312		1 4518	0 8158
	n-Undecylcyclohexane (n-Hendecylcyclohexane)	316	5 8	1 4547	0 8206
	n-Tridecylcyclopentane	327	5	1 4531	0 8178
	n-Dodecylcyclohexane	331	12 5	1 4559	0 8223
278	n-Tetradecylcyclopentane	341	9	1 4543	0 8196

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

### TABLE I. ALKANES AND CYCLOALKANES b) Solids (Listed in order of increasing m.p.\*)\*\*

lo.	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub>	D <sub>4</sub>	
1	Pentadecylcyclopentane	17	355	1.455420	0.821320	
2	n-Hexadecane (Cetane)	18.165	286.793; 105.201	1.4345320	0.773420	
3	Tridecylcyclohexane	18.5	346	1.457020	0.823920	
4	Hexadecylcyclopentane	21		1.454325	0.819425	
5	n-Heptadecane	21.98	301.82;	1.434825;	0.774525;	
٠	, inchinate and	21.70	117.261	1.4369%	0.778020	
6	Tetradecylcyclohexane	24		1.455925	0.822125	
7	Heptadecylcyclopentane	27		1.453230	0.817330	
٨	n-Octadecane.	28.18	316.12;	1.419170;	0.775130;	
Ĭ	To Consider the Constitution of the Constituti	20.10	128.28	1.439020	0.781920	
ا و	Pentadecylcyclohexane	29		1.454530	0.820130	
ól	Octadecylcyclopentane	30		1.454130	0.818630	
ĭ	n-Nonadecane	32.1	329.7;	1.421170;	0.778730;	
1	n-ivoliquetant	32.1	138.81	1.440910	0.785529	
٦,	Hexadecylcyclohexane	33.6	150.0	1.4596%	0.827929	
3	Nonadecylcyclonexane	35.0		1.4588%	0.826620	
4	n-Eicosane	36.8	342.7;	1.423070:	0.755070;	
۱,	n-Energant,	50.0	148.91	1.44267	0.788720	
اء	Heptadecylcyclohexane	37.8	140.7	1.4603?	0.8290?	
6	Eicosylcyclopentane	38		1.4595%	0.827629	
7	n-Heneicosane	40.5	356.5;	1.424770;	0.758370;	
1	n-rieseicosane	40.5	152.941	1.444120	0.791729	
8	Outodo selos de la secono	41.4	1 ' 1	•	0.8300%	
ە ا		41.6		1.461020	"	
1	Heneicosylcyclopentane	42	349.4.	1.4602 <sup>20</sup>	0.8286 <sup>20</sup> 0.7631 <sup>70</sup>	
ᅃ	n-Docosane	44.4 (47)	368.6;	1.426070;	0.7631**	
. [	P 1 1 1	45	161.881	1.4455 <sup>20</sup>	0.030520	
1	Docosylcyclopentane	45		1.4608 <sup>20</sup>	0.8295 <sup>20</sup>	
2	Nonadecylcyclohexane	45.2	200.0	1.4616 <sup>20</sup>	0.8310 <sup>20</sup>	
3	n-Tricosane	47.6	380.2;	1.427620;	0.764170;	
. 1			170.481	1.446820	0.796920	
- 1	Eicosylcyclohexane	48.5		1.462220	0.831820	
- 1	Tricosylcyclopentane	49		1.461420	0.830420	
6	n-Tetracosane	50.9	391.3;	1.428670;	0.765776;	
_	_		178.71	1.448020	0.799120	
•	Tetracosylcyclopentane	51		1.4619 <sup>20</sup>	0.831220	
	Heneicosylcyclohexane	51.5		1.4627 <sup>20</sup>	0.8326 <sup>20</sup>	
9	n-Pentacosane	53.7	401.9;	1.430270;	0.769370;	
1	}		186.551	1.4491 <sup>20</sup>	0.801220	
- 1	Pentacosylcyclopentane	54		1.4624 <sup>20</sup>	0.8319ლ	
- 1	Docosylcyclohexane	54.4		1.463220	0.833420	
	Hexacosylcyclopentane	56		1.4628 <sup>20</sup>	0.8326℃	
- 1	Nortricyclene (Tricyclo[2.2.1.0 <sup>2.6</sup> ]heptane)	56	106~7			
4	n-Hexacosane	56.4	412.2;	1.4310 <sup>70</sup> ;	0.770470;	
١			194.181	1.4501 <sup>20</sup>	0.8032℃	
- 1	Cyclohexadecane	57	93-80.8			
6	Tricosylcyclohexane	57		$1.4637_{\mathrm{U}}^{20}$	0.83412°	
7	Heptacosylcyclopentane	59		1.4633 <sup>20</sup>	0.8333 <sup>20</sup>	
8	n-Heptacosane	59.0	422.1;	1.432170;	0.773270;	
			201.541	1.451120	0.8050²º	
9	Tetracosylcyclohexane	59.5		1.4641 <sup>20</sup>	0.8347 <sup>20</sup>	
٥Į	Cyclopentadecane	60-1		1.459261.5	0.863461.5	
ı	Octacosylcyclopentane	61		1.4637 <sup>20</sup>	0.8339 <sup>20</sup>	
2	n-Octacosane	61.4	431.6;	1.433070;	0.775070;	
1			208.581	1.4520 <sup>20</sup>	0.8067 <sup>ლ</sup>	
3	Pentacosylcyclohexane	61.9		1.4645%	0.8353 <sup>20</sup>	
	Nonacosylcyclopentane	63		1.464020	0.834520	
	n-Nonacosane	63.7	440.8;	0.779765;	1.436165:	
,,,						

<sup>\*</sup>Derivative data given in order: m.p., crystal color, solvent from which crystallized.

<sup>\*\*</sup>U = undercooled liquid.

# TABLE I. ALKANES AND CYCLOALKANES b) Solids (Listed in order of increasing m.p.\*)\*\*(Continued)

7-Triacontane  Heptacosylcyc Hentriacontylc n-Hentriacontylc p-Hentriacontan  Cotacosylcycle Dotriacontan  Nonacosylcycle Tritriacontan Tritriacontan Tritriacontan  Especial Pentatriacontylc Pentatriacontylc Pentatriacontylc Pentatriacontylc Hexatriacontyl Hexatriacontyl Hexatriacontyl Hexatriacontyl Tetratriacontyl Hexatriacontyl Hexatriacontyl Hexatriacontyl Cotatriacontan Tetratriacontyl Nonatriacontan Hexatriacontyl Tetratriacontyl Hexatriacontyl	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub>	D <sub>4</sub>
Triacontylcycle d,l-Isobornane (2,2,3-Trimet) n-Triacontane  Heptacosylcycle Hentriacontylcy n-Hentriaconts  Octacosylcycle Dotriacontane  Nonacosylcycle Tritriacontylcycle Tritriacontylcycle Tritriacontylcycle Tetratriacontylcycle Tetratriacontylcycle Hentriacontylcycle Tetratriacontylcycle Hentriacontylcycle Hentriacontylcycle Tetratriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcycle Hentriacontylcy Hentatriacontylcy Hexatriacontylcy Hexatriacontylcy Heptatriacontan Tritriacontylcy Heptatriacontan Pentatriacontyl Hexatriacontyl	osylcyclohexane	64		1 4649%	0 835920
48 d./-Isobornane (2,2,3-Trimet n-Triacontane  50 Heptacosylcycle hentriacontylcy 22 n-Hentriacontane  53 Octacosylcycle Dotriacontane  54 Nonacosylcycle 55 n-Dotriacontane  56 Nonacosylcycle 57 Tritriacontane 58 Tritriacontane 59 Tritriacontylcycle 60 Tetratriacontylcycle 61 Tetratriacontylcycle 62 28-Methylnona 63 Hentriacontylc 64 Pentatriacontylc 65 Pentatriacontylc 66 Hexatriaconta 67 Hexatriacontane 67 Tetratriacontylc 70 Heptatriacontyl 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontan 74 Nonatriacontan 75 Hexatriacontan 76 Tetracontane 77 Norbornane (B	• •	65		1 4644 20	0 835070
49 n-Triacontane 50 Heptacosylcycle 51 Hentriacontylcy 52 n-Hentriacontylcy 53 Octacosylcycle 54 Dotriacontane 56 Nonacosylcycle 57 Tritriacontylcy 58 Tritriacontylcy 60 Tetratriacontylcy 61 Tetratriacontylcy 62 28-Methylnona 63 Hentriacontylcy 64 Pentatriacontylcy 65 Pentatriacontylcy 66 Hexatriacontylcy 67 Hexatriacontane 68 Dotriacontane 69 Tritriacontylcy 69 Hexatriacontylcy 70 Heptatriacontan 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontan 75 Hexatriacontyl 76 Tetracontane 77 Nonatriacontan 77 Nonatriacontane 77 Norbornane (B		65-7		1 4418667	0 8275767
49 n-Triacontane 50 Heptacosylcyc 51 Hentriacontylc 52 n-Hentriaconts 53 Octacosylcycle 54 Dotriacontane 56 Nonacosylcycle 57 Tritriacontylcy 58 Tritriacontylcy 60 Tetratriacont 61 Tetratriacontylc 62 28-Methylnona 63 Hentriacontylc 64 Pentatriacontylc 65 Pentatriacontylc 66 Hexatriacontylc 67 Hexatriacontyl 68 Hexatriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 62 Tritriacontyl 63 Hexatriacontyl 64 Pentatriacontyl 65 Hexatriacontyl 66 Hexatriacontyl 67 Hexatriacontyl 68 Hexatriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 62 Tetratriacontyl 63 Tetratriacontyl 64 Pentatriacontyl 65 Tetratriacontyl 66 Tetratriacontyl 67 Tetratriacontyl 68 Hexatriacontyl 69 Tetratriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 61 Tetratriacontyl 62 Tetratriacontyl 63 Tetratriacontyl 64 Tetratriacontyl 65 Tetratriacontyl 66 Tetratriacontyl 67 Tetratriacontyl 68 Tetratriacontyl 69 Tetratriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 61 Tetratriacontyl 62 Tetratriacontyl 63 Tetratriacontyl 64 Tetratriacontyl 65 Tetratriacontyl 66 Tetratriacontyl 67 Tetratriacontyl 67 Tetratriacontyl 68 Tetratriacontyl 69 Tetratriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 61 Tetratriacontyl 62 Tetratriacontyl 63 Tetratriacontyl 64 Tetratriacontyl 65 Tetratriacontyl 66 Tetratriacontyl 66 Tetratriacontyl 67 Tetratriacontyl 68 Tetratriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 61 Tetratriacontyl 62 Tetratriacontyl 63 Tetratriacontyl 64 Tetratriacontyl 65 Tetratriacontyl 65 Tetratriacontyl 66 Tetratriacontyl 67 Tetratriacontyl 67 Tetratriacontyl 68 Tetratriacontyl 68 Tetratriacontyl 69 Tetratriacontyl 60 Tetratriacontyl 60 Tetratriacontyl 60 Tetratriacontyl 61 Tetratriacontyl 61 Tetratriacontyl 61 Tetratriacontyl 62 Tetratriacontyl 63 Tetratriacontyl 64 Tetratriacontyl 65 Tetratriacontyl 65 Tetratriacontyl 66 Tetratriacontyl 67 Tetratriacontyl 67 Tetratriacont	-Trimethylbicyclo[2 2 1]heptane)	00 /		1	0 02.57
50 Heptacosylcycle 51 Hentriacontylcy 52 n-Hentriaconts 53 Octacosylcycle 54 Dotriacontar 55 Nonacosylcycle 57 Tritriacontylcy 58 Tritriacontylcycle 60 Tetratriacontylcycle 61 Tetratriacontylcycle 62 28-Methylnona 63 Hentriacontylcy 64 Pentatriacontylcy 65 Pentatriacontylcy 66 Pentatriacontylcy 67 Hexatriacontylcy 68 Hexatriacontylcy 69 Hexatriacontylcy 70 Heptatriaconta 71 Tetratriacontylcy 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontan 75 Hexatriacontyl 76 Tetracontan 77 Nonatriacontan 78 Hexatriacontyl 79 Tetracontan 70 Tetracontan 71 Tetracontan 71 Tetracontan 72 Nonatriacontan 73 Pentatriacontyl 74 Nonatriacontan 75 Hexatriacontyl 76 Tetracontane 77 Nonatriacontan 78 Norbornane (B		65 8	449 7,	1 434870,	0 779770.
51 Hentriacontyle 52 n-Hentriacontyle 53 Octacosyleyele 54 Dotriacontar 55 Nonacosyleyele 57 Tritriacontyle 58 Tritriacontyle 59 Tritriacontyle 60 Tetratriacontyl 61 Tetratriacontyl 62 28-Methylnona 64 Pentatriacontyl 65 Pentatriacontyl 66 Pentatriacontyl 67 Hexatriacontyl 68 Tritriacontyl 69 Tritriacontyl 69 Pentatriacontyl 60 Tritriacontyl 61 Tritriacontyl 62 Pentatriacontyl 63 Tritriacontyl 64 Pentatriacontyl 65 Pentatriacontyl 66 Tritriacontyl 67 Hexatriacontyl 68 Tritriacontyl 69 Tritriacontyl 60 Tritriacontyl 61 Tetratriacontyl 62 Tritriacontan 63 Tritriacontyl 64 Pentatriacontyl 65 Hexatriacontyl 66 Tritriacontan 67 Nonatriacontan 67 Nonatriacontan 67 Norbornane (B	Contains		222 001	1 4536%	0 809710
51 Hentriacontyle 52 n-Hentriacontyle 53 Octacosylcycle 54 Dotriacontar 55 Nonacosylcycle 57 Tritriacontyle 58 Tritriacontyle 59 Tritriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 62 28-Methylnona 63 Hentriacontyle 64 Pentatriacontyle 65 Pentatriacontyle 66 Pentatriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 69 Tritriacontyle 69 Tritriacontyle 60 Tritriacontyle 61 Tritriacontyle 62 Tritriacontyle 63 Hexatriacontyle 64 Pentatriacontyle 65 Pentatriacontyle 66 Tritriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 69 Tritriacontyle 60 Tritriacontyle 61 Tritriacontyle 62 Tritriacontyle 63 Hexatriacontyle 64 Pentatriacontyle 65 Hexatriacontyle 66 Tritriacontyle 67 Hexatriacontyle 68 Tritriacontyle 69 Tritriacontyle 69 Tritriacontyle 60 Tetratriacontyle 60 Tritriacontyle 61 Tritriacontyle 62 Tritriacontyle 63 Hexatriacontyle 64 Pentatriacontyle 65 Hexatriacontyle 66 Tritriacontyle 67 Hexatriacontyle 67 Hexatriacontyle 68 Tritriacontyle 69 Tritriacontyle 60 Tetratriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 61 Tetratriacontyle 62 Tetratriacontyle 63 Hentriacontyle 64 Pentatriacontyle 65 Hexatriacontyle 66 Tritriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 69 Tritriacontyle 60 Tetratriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 62 Tetratriacontyle 63 Hentriacontyle 64 Pentatriacontyle 65 Hexatriacontyle 66 Tetratriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 69 Tetratriacontyle 60 Tetratriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 61 Tetratriacontyle 62 Tetratriacontyle 63 Hentriacontyle 64 Pentatriacontyle 65 Tetratriacontyle 66 Tetratriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 69 Tetratriacontyle 60 Tetratriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 61 Tetratriacontyle 62 Tetratriacontyle 62 Tetratriacontyle 63 Tetratriacontyle 64 Pentatriacontyle 65 Tetratriacontyle 66 Tetratriacontyle 67 Hexatriacontyle 67 Hexatriacontyle 68 Tetratriacontyle 69 Tetratriacontyle 60 Tetratriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 61 Tetratriacontyle 62 Tetratriacontyle 63 Tetratriacontyle	cosylcyclohex ane	66 1		1 4653%	0 836529
52 n-Hentriaconta 53 Octacosylcycle 54 Dotriacontar 55 n-Dotriacontar 56 Nonacosylcycle 57 Tritriacontylcy 58 Tritriacontylcy 59 Tritriacontylcy 60 Tetratriacontyl 61 Tetratriacontal 62 28-Methylnona 63 Hentriacontal 64 Pentatriacontyl 65 Pentatriacontyl 66 Pentatriacontyl 67 Hexatriacontyl 68 Hexatriacontyl 69 Tritriacontyl 69 Tritriacontyl 60 Tritriacontyl 61 Tetratriacontyl 62 Hexatriacontyl 63 Hexatriacontyl 64 Pentatriacontyl 65 Pentatriacontyl 66 Tritriacontyl 67 Hexatriacontyl 68 Hexatriacontyl 69 Tritriacontan 60 Tritriacontan 60 Tritriacontan 61 Tetratriacontyl 61 Tetracontan 62 Tritriacontan 63 Tritriacontan 64 Tritriacontan 65 Tritriacontan 66 Tritriacontan 67 Tritriacontan 67 Tritriacontan 68 Tritriacontan 69 Tritriacontan 69 Tritriacontan 69 Tritriacontan 60 Tritriacontan 60 Tritriacontan 61 Tritriacontan 62 Tritriacontan 63 Tritriacontan 64 Tritriacontan 65 Tritriacontan 66 Tritriacontan 67 Tritriacontan 67 Tritriacontan 68 Tritriacontan 69 Tritriacontan 69 Tritriacontan 69 Tritriacontan 60 Tritriacontan 60 Tritriacontan 61 Tritriacontan 62 Tritriacontan 63 Tritriacontan 64 Tritriacontan 65 Tritriacontan 66 Tritriacontan 67 Tritriacontan 67 Tritriacontan 68 Tritriacontan 69 Tritriacontan 69 Tritriacontan 60 Tritriacontan 60 Tritriacontan 60 Tritriacontan 61 Tritriacontan 62 Tritriacontan 63 Tritriacontan 64 Tritriacontan 65 Tritriacontan 66 Tritriacontan 67 Tritriacontan 67 Tritriacontan 68 Tritriacontan 69 Tritriacontan 69 Tritriacontan 60 Tritriacontan 60 Tritriacontan 60 Tritriacontan 60 Tritriacontan 61 Tritriacontan 61 Tritriacontan 62 Tritriacontan 63 Tritriacontan 64 Tritriacontan 65 Tritriacontan 66 Tritriacontan 67 Tritriacontan 67 Tritriacontan 68 Tritriacontan 69 Tritriacontan 69 Tritriacontan 60 Tritriacontan 60 Tritriacontan 60 Tritriacontan 60 Tritriacontan 61 Tritriacontan 61 Tritriacontan 62 Tritriacontan 63 Tritriacontan 64 Tritriacontan 65 Tritriacontan 66 Tritriacontan 67 Tritri	acontylcyclopentane	67		1 464820	0 8356%
53 Octacosylcycle 54 Dotriacontar 55 n-Dotriacontar 56 Nonacosylcycle 57 Tritriacontar 58 Tritriacontar 59 Triacontylcycle 60 Tetratriacontylc 61 Tetratriacontylc 62 28-Methylnona 63 Hentriacontylc 64 Pentatriacontylc 65 Pentatriacontylc 66 Hexatriacontyl 67 Hexatriacontyl 68 Tritriacontylc 69 Tritriacontylc 60 Tritriacontylc 61 Tritriacontylc 62 Hexatriacontyl 63 Tritriacontyl 64 Pentatriacontyl 65 Hexatriacontyl 66 Tetratriacontyl 67 Hexatriacontyl 68 Tritriacontyl 69 Tritriacontar 69 Tritriacontar 69 Tritriacontar 69 Tritriacontar 60 Tritriacontar 60 Tritriacontar 61 Tritriacontar 62 Tritriacontar 63 Tritriacontar 64 Tritriacontyl 65 Tritriacontar 66 Tritriacontar 67 Nonatriacontar 67 Nonatriacontar 67 Norbornane (B		67.9	458.	1 4543 20	0 811120
54 Dotriacontyley 55 n-Dotriacontar 56 Nonacosyleyck 57 Tritriacontyley 58 Tritriacontyley 60 Tetratriacontyl 61 Tetratriacontyle 62 28-Methylnona 63 Hentriacontyle 64 Pentatriacontyle 65 Pentatriacontyle 66 Dotriacontariaconta 67 Hexatriacontar 68 Tritriacontyle 69 Hexatriacontyle 60 Tetratriacontyle 61 Tetratriacontyle 62 Hexatriacontyle 63 Hexatriacontyle 64 Pentatriacontyle 65 Hexatriacontyle 66 Tetratriacontyle 77 Hexatriacontyl 78 Hexatriacontyl 79 Hexatriacontyl 70 Tetratriacontyl 71 Tetratriacontyl 72 Tetratriacontyl 73 Tetratriacontyl 74 Nonatriacontar 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	macontanc	0, ,	184 170 1	1 13130	0 01110
54 Dotriacontyley 55 n-Dotriacontar 56 Nonacosylcyck 57 Tritriacontyley 58 Tritriacontyley 60 Tetratriaconta 61 Tetratriacontyle 62 28-Methylnona 63 Hentriacontyle 64 Pentatriacontyle 65 Pentatriaconty 66 Dotriacontar 66 Dotriacontar 67 Hexatriaconta 69 Tritriacontyle 69 Hexatriacontar 70 Heptatriacontar 71 Tetratriacontyl 72 Octatriacontar 73 Pentatriaconty 74 Nonatriacontar 75 Hexatriacontar 76 Tetratriaconty 77 Hexatriaconty 78 Hexatriaconty 79 Hexatriacontar 70 Hexatriacontar 71 Tetratriaconty 72 Hexatriacontar 73 Hexatriacontar 74 Nonatriacontar 75 Hexatriacontar 76 Tetracontane 77 Norbornane (B	nsvicyclohexane	68	10.17	1 465620	0 837020
55 n-Dotriacontar 56 Nonacosylcycle 57 Tritriacontylcy 58 Tritriacontane 59 Triacontylcycle 60 Tetratriacontylc 61 Tetratriacontylc 62 28-Methylnona 63 Hentriacontylc 64 Pentatriacontylc 65 Pentatriacontylc 66 Hexatriacontylc 67 Hexatriacontal 69 Tritriacontylc 70 Heptatriacontal 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontan 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	contylcyclopentane	69		1 46517	0 8360%
56 Nonacosylcycle 57 Tritriacontylcy 58 Tritriacontane 59 Triacontylcycle 60 Tetratriacontyl 61 Tetratriacontal 62 28-Methylnona 63 Hentriacontylc 64 Pentatriacontylc 65 Pentatriacontylc 66 Hexatriacontal 67 Tritriacontylc 68 Hexatriacontal 69 Tritriacontylc 70 Heptatriacontal 71 Tetratriacontal 72 Octatriacontal 73 Pentatriacontyl 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		69 7	467.	1 4550g	0 779175.
57 Tritriacontylcy 58 Tritriacontane 59 Triacontylcycle 60 Tetratriacontyl 61 Tetratriacontyl 62 28-Methylnona 63 Hentriacontyl 64 Pentatriacontyl 65 Pentatriacontyl 67 Hexatriacontyl 68 Hexatriacontyl 69 Tritriacontyl 70 Heptatriaconta 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriaconta 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	racontaine (Bicety)	0,7	234 81	1 .5500	0 812470
57 Tritriacontylcy 58 Tritriacontane 59 Triacontylcycle 60 Tetratriacontyl 61 Tetratriacontyl 62 28-Methylnona 63 Hentriacontyl 64 Pentatriacontyl 65 Pentatriacontyl 67 Hexatriacontyl 68 Hexatriacontyl 69 Tritriacontyl 70 Heptatriaconta 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriaconta 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	osvicuciohevane	69 9	2540	1 465920	0 837420
58 Tritriacontane 59 Triacontylcycle 60 Tetratriacontyl 61 Tetratriacontyl 62 28-Methylnona 63 Hentriacontyl 64 Pentatriacontyl 65 Pentatriacontyl 66 Dotriacontyl 67 Hexatriacontyl 68 Hexatriacontyl 69 Tritriacontyl 70 Heptatriaconta 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontat 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	• •	70		1 465420	0 8365%
59 Triacontylcycle 60 Tetratriacontyl 61 Tetratriacontyl 62 28-Methylnona 63 Hentriacontyl 65 Pentatriacontal 66 Dotriacontal 67 Hexatriacontyl 68 Hexatriacontyl 69 Tritriacontyl 69 Tritriacontyl 70 Heptatriacontyl 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontan 77 Nonatriacontan 77 Nonatriacontan 78 Norbornane (B		71 4		1 455710	0 8136%
60 Tetratriacontyle 61 Tetratriacontyle 62 28-Methylnona 63 Hentriacontyle 64 Pentatriacontyle 65 Pentatriacontyle 66 Hexatriacontal 67 Tritriacontyle 68 Hexatriacontal 69 Tritriacontyle 70 Heptatriacontal 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		71 6		1 466220	0 837920
61 Tetratriaconta  62 28-Methylnona 63 Hentriacontylc 64 Pentatriaconts 65 Dotriaconta 66 Dotriaconta 67 Hexatriaconta 68 Tritriacontylc 70 Heptatriaconta 71 Tetratriacontyl 72 Octatriaconta 73 Pentatriaconta 74 Nonatriaconta 75 Hexatriaconta 76 Tetracontan 77 Hexatriaconta 77 Hexatriacontan 78 Horosontan 79 Norbornane (B	riacontylcyclopentane	72		1 4657%	0 8370%
62 28-Methylnona 63 Hentriacontylc 64 Pentatriacontylc 65 Pentatriacontylc 67 Hexatriacontylc 68 Hexatriacontylc 70 Heptatriacontylc 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontan 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontan 77 Nonatriacontal 78 Hexatriacontyl 79 Nonatriacontal 70 Norbornane (B		72 6,	285 43	I 4296%	0 772890
63 Hentriacontyle 64 Pentatriacontyle 65 Pentatriaconts 66 Dotriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 70 Tritriacontyle 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriaconts 74 Nonatriaconts 75 Hexatriacontyl 76 Tetracontan 77 Noratriacontan 78 Norbornane (B	natontane	73 1	203 4	1 4563?	0 814820
63 Hentriacontyle 64 Pentatriacontyle 65 Pentatriaconts 66 Dotriacontyle 67 Hexatriacontyle 68 Hexatriacontyle 70 Tritriacontyle 71 Tetratriaconts 72 Octatriacontan 73 Pentatriaconts 74 Nonatriaconts 75 Hexatriacontyl 76 Tetracontan 77 Nonatriacontan 78 Hexatriacontyl 79 Nonatriacontan 70 Nonatriacontan 71 Nonatriacontan 72 Nonatriacontan 73 Nonatriacontan 74 Nonatriacontan 75 Hexatriacontyl 76 Tetracontan 77 Nonatriacontan 78 Norbornane (B	thulmonacosano	73 4	2220 3	1 45050	0 01401
64 Pentatriaconty 65 Pentatriaconta 66 Dotriacontyley 67 Hexatriaconta 69 Tritriacontyley 70 Heptatriaconta 71 Tetratriaconty 72 Octatriacontan 73 Pentatriaconta 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontan 77 Norbornane (B	•	73 3	222	1 4665%	0 838320
65 Pentatriaconta 66 Dotriacontylcy 67 Hexatriacontal 69 Tritriacontylcy 70 Heptatriacontal 71 Tetratriacontal 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontan 77 Noratriacontal 77 Noratriacontal 78 Norbornane (B		74		1 4660%	0 837420
66 Dotriacontyley 67 Hexatriacontyley 68 Hexatriacontal 69 Tritriacontyley 70 Heptatriacontal 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriacontyl 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		74 7	331	1 4568%	0 815710
67 Hexatriacontyl 68 Hexatriacontal 69 Tritriacontal 70 Heptatriacontal 71 Tetratriacontal 72 Octatriacontan 73 Pentatriacontal 74 Nonatriacontal 75 Hexatriacontal 76 Tetracontane 77 Norbornane (B		74 8	331	1 4668%	0 8388 20
68 Hexatriacontai 69 Tritriacontyley 70 Heptatriaconty 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriaconta 74 Nonatriacontai 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		75		1 466220	0 837820
69 Tritriacontylcy 70 Heptatriaconta 71 Tetratriacontyl 72 Octatriaconta 73 Pentatriaconty 74 Nonatriaconta 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		76 2		1 457320	0 8169%
70 Heptatriaconta 71 Tetratriacontyl 72 Octatriacontan 73 Pentatriaconty 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		76 3		1 4670%	0 839120
71 Tetratriacontyl 72 Octatriacontan 73 Pentatriaconty 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		77 7		1 4578 20	0 817910
72 Octatriacontan 73 Pentatriaconty 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		77 7		1 467329	0 8395%
73 Pentatriaconty 74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	· -	79		1 4583%	0 818820
74 Nonatriacontal 75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B		79 1		1 467520	0 839920
75 Hexatriacontyl 76 Tetracontane 77 Norbornane (B	• •	80 3		1 458820	0 8197%
76 Tetracontane 77 Norbornane (B	riacontalie riacontylcyclohexane	80 4		1 4678%	0 840220
77 Norbornane (B		81.5		1 459320	0 820520
	rnane (Bicyclo[2 2 1]heptane)	86-7, subl		1 32250	0 02000
	-Tetramethylbutane	100 69	106 47	1 469520	0 8242230hd
79 Bornane (Cam	•	158 9, subl	100 47	1 7073	O OZ-IZSONA
80 Adamantane	•	268 (252 3)		1 568	1 07 <sub>solid</sub>

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

<sup>\*\*</sup>U = undercooled liquid

#### EXPLANATIONS AND REFERENCES TO TABLE II

Bromine addition compound.\*

$$RCH = CHR' + Br_2 \rightarrow RCHBr - CHBrR'$$

Bromine addition compound

From the alkene and bromine in carbon tetrachloride.

For directions and examples see: Cheronis, p. 576; Shriner, p. 106.

From the alkene and bromine in water.

See: Vogel, p. 241.

From the alkene and bromine in chloroform.

See: C. G. Schmitt and C. E. Boord, J. Amer. Chem. Soc., 54, 751 (1932).

#### 2,4-Dinitrobenzenesulfenyl chloride addition compound.\*

$$RCH = CHR' + O_2N \longrightarrow SCI \rightarrow RCHCI - CHR'S \longrightarrow NO_2$$

$$2.4-Dinitrobenzenesulfenyl chloride adduct$$

From the alkene and 2,4-dinitrobenzenesulfenyl chloride in glacial acetic acid.

For directions and examples see: Cheronis, p. 577; N. Kharasch and C. M. Buess, J. Amer. Chem. Soc., 71, 2724 (1949); D. J. Cram, J. Amer. Chem. Soc., 71, 3883 (1949); N. Kharasch, C. M. Buess and S. I. Strashun, J. Amer. Chem. Soc., 74, 3422 (1952).

From the alkene and 2,4-dinitrobenzenesulfenyl chloride in benzene or in carbon tetrachloride.

See: N. Kharasch and C. M. Buess, J. Amer. Chem. Soc., 71, 2724 (1949).

#### S-Alkylmercaptosuccinic acid.\*

From the alkene, mercaptosuccinic acid and benzoyl peroxide in methanol.

For directions and examples see: J. G. Hendrickson and L. F. Hatch, J. Org. Chem., 25, 1747 (1960).

#### Maleic anhydride adduct (from dienes).

From the diene and maleic anhydride in benzene.

For directions and examples see: Linstead, p. 51; Vogel, p. 943.

From the diene and maleic anhydride in xylene.

See: Linstead, p. 51.

For general references see: M. C. Kloetzel in Organic Reactions, Vol. 4 (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 1; H. L. Holmes in Organic Reactions, Vol. 4, (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 60; O. Diels and K. Alder, Chem. Ber., 62, 2081 (1929).

Nitrosochloride addition compound.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

#### **EXPLANATIONS AND REFERENCES TO TABLE II (Continued)**

From the alkene and nitrosyl chloride (prepared from sodium nitrite in concentrated hydrochloric acid) in ether-acetic acid mixture.

For directions and examples see: Linstead, p. 52; R. Perrot, Compt. Rend., 203, 329 (1936).

From the alkene and nitrosyl chloride (prepared from thionyl chloride and nitrogen trioxide) in ether.

See: M. Tuot, Compt. Rend., 204, 697 (1937).

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

a) Liquids 1) (Listed in order of increasing b.p.\*)\*\*

		Boiling	Melting				Bro	mine addition	product		
No	Name	point °C	point °C	n 20 D	D <sub>4</sub> 20	x-Bromo-	BP,°C	MP,°C	n 20	D20	Miscellaneous
1	Ethene (Ethylene)	- 103 71	- 169 15 <sup>T</sup>		0 3840	dı-	131 36	9 85	1 53868	2 1792	
2	Propene (Propylene)	- 47 70	$-185\ 25^{\mathrm{T}}$		0 5139	dı-	141 99	-55 5	1 52004	1 93268	
3	Cyclopropene	- 36741	1						ļ		
4	Allene	_ 34 5	-136		ł	tetra-	İ	10 7	1 6200	2 703	
5	2-Methylpropene	-6 90	- 140 35	1 3467	0 5942 <sup>s</sup>	dı-	149		1 5080	1 7595	2,4 Dinitrophenyl-
											sulfenyl chloride, 86 7
6	1-Butene	-6 26	-185 35	1 3465	0 5951	dı-	166 3		1 5150	1 7951	2,4-Dinitrophenyl- sulfenyl chloride, 77 5 8 5
7	1,3-Butadiene	-441	-108 92	1 4292 2	0 6255 '	tetra-		118 lgr			
8	trans-2-Butene	0 88	- 105 55		0 6042 <sup>s</sup>	dı-	161 0	}	1 5110	1 7852	
9	Cyclobutene	2 4			0 7330	"	•	1			]
10	cis 2-Butene	3 72	- 138 91		0 63061	dı-	161 0		1 5110	1 7852	
	1,2-Butadiene	10 85	-136 19	1 4208	0 652 <sup>s</sup>	tetra-	97.5	_2	1 6070	2 5085	
l ''	(Methylallene)	1.000	.55 .7		3 032		´ ` `	_	. 55.6	3303	
12	3-Methyl-1-butene	20 06	- 168 49	1 3643	0 6272	dı-	61 212		1 50932	1 6776	
	1,4-Pentadiene	25 97	-148 28	1 38876	0 66706	tetra	0, 2	85 5 6 0.	1 30732	1.0770	
1.3	1,4-1 Cilladiciic	23 //	140 20	1 30070	0 00700	iciru		eth			
14	1-Pentene	29 97	- 165 22	1 37148	0 64050	dı-	6812	- Ci.ii	1 501212	1 59219	Mercaptosuccinic acid adduct, 107 3 6
15	2-Methyl-1-butene	31 16	- 137 56	1 3778	0 6504	dı-	47 4 489		1 5088	1 6711	Mercaptosuccinic acid adduct, 122 3- 6
16	3-Methylcyclobutene	32	1	1 4005	İ						
	2-Methyl-1,3-	34 07	- 145 95	1 42194	0 68095	dı-	90-612				Maleic anh adduct,
	butadiene (Isoprene)					tetra-	155				63-4, lgr
		1					6012				
18	trans-2-Pentene	36 35	- 140 24	1 3793	0 6482	dı-	91 050		1 5096	1 6809	
19	cis-2-Pentene	36 94	-151 39	1 3830	0 6556	dı-	92 450		1 5096	1 6817	
20	1-Methyl-1-cyclo-	37 1		1 4088	0 7244						
	butene										
21	2-Methvl-2-butene	38 57	-133 77	1 3874	0 6623						Nitrosochloride, 74, Mercaptosuccinic acid adduct, 153 7-4 0
22	3-Methyl-1,2-buta-	40		1 410	0 680	tetra-	150 21		1 59417	2 30517	155 / 40
	diene (1   Dimethylallene)				0 000	10.74	150 2			2 303	
23	Cyclopentadiene	40 83 2	-85	1 439819 5	0 798319						Dimer 32, Maleic
23	Cyclopelladicite	40 03	-03	1 12/0	0 7703					i	anh adduct, 164 5 Benzoquinone adduct, 75 6
24	1,3-Pentadiene (Piperylene)	411	-889	1 4309	0 6803	tetra-		114 5, al			Maleic anh adduct, 61, pet eth , Oxid by KMnO <sub>4</sub> → HCOOH + CH <sub>3</sub> COOH
25	3,3-Dimethyl-1-butene	41 24	-1152	1 3760	0 6529	dı-	95 3 5 6 <sup>10</sup>		1 5109	1 5615	сизсооп
26 27		42 03 44 07	87 47 140 82	1 43008 1 43634	0 67603 0 69102	tetra- tetra-	131 <sup>3</sup>	115, al 115, al			

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

<sup>\*\*</sup>T = triple point, S = at saturation pressure

		Boiling	Melting			T -	Bro	omine addition	product		
No	Name	point °C	point °C	n 20 D	D <sub>4</sub> o	x Bromo-	BP ℃	MP °C	n 20 D	D <sub>4</sub> <sup>20</sup>	Miscellaneous
28	Cyclopentene	44 24	-135 08	1 42246	0 77199	dı-	71 512		1 5510''	1 871311	Mercaptosuccinic acid adduct 142 8 3 1 Pseudo-nitrosite 69 70 Perbenzoic acid oxid → epoxycyclopentane b p 102 3
29	1,2-Pentadiene (Ethylallene)	44 86	- 137 26	1 42091	0 69257	tetra-	94 601			2 34691;	
30	2,3-Pentadiene (1 3- Dimethylallene)	48 27	-125 26	1 42842	0 69502						
31	4-Methyl-1-pentene	53 88	-153 63	1 3828	0 6642	dı	8721		1 4980	1 5689	Mercaptosuccinic acid adduct 102 6 9
	3-Methyl-1-pentene 3-Methyl-1,4-penta- diene	54 14 55	-153 0	1 3842 1 405	0 6675 0 695	dı	99™	<b>!</b>	1 5060	1 6016	
34 35	2,3-Dimethyl-1-butene	55 67 56	-157 27	1 3904 1 405	0 6779 0 694	dı-	801		1 5105	1 6033	
36	4-Methyl- <i>cis</i> -2- pentene	56 3	-134 43	1 3880	0 6690	dı	72 31×		1 5060	1 5983	
37	4-Methyl-trans-2- pentene	58 55	-140 81	1 3889	0 6686	dı-	7822		1 5070	1 5996	
38	1,5-Hexadiene (Bıallyl)	59 46	- 140 8	1 4042	0 6923	tetra-		52			Dil HNO <sub>3</sub> → suc- cinic ac 185
39 40	2-Methyl-1-pentene 1-Hexene	60 7 63 49	- 135 72 - 139 82	1 3920 1 38788	0 6817 0 67317	dı dı-	87 8 <sup>20</sup> 89 90 <sup>18</sup>		1 5015 1 5024	1 5581 1 5774	2,4-Dinitrophenyl- sulfenyl chloride 61 2 Mercapto- succinic acid ad- duct, 94 5 5 7
42	2-Ethyl-1-butene trans-1,3-Hexadiene	64 6 64 5 5 5	-131 53	1 3969 1 4060 <sup>19</sup>	0 6894 0 6925 <sup>19</sup>	dı- tetra-	8721	19	1 5112	1 6045	duct, 713 37
43 44	3-Methylcyclopentene cis-3-Hexene	65 0 66 44	-137 82	1 4207 1 3947	0 7622 0 6796	dı	80 113		1 5045	1 6027	
	3-Hexene (cis-trans mixture)	66 6-67		1 3942	0 6816	dı-	80 113		1 5045	1 6027	
46		67 08	-113 43	1 3943	0 6772	dı-	80 113		1 5045	1 6027	
47	2-Methyl-2-pentene	67 29	- 135 7	1 4004	0 6863	dı-	71-218		1 5063	1 5849	Mercaptosuccinic acid adduct, 152 1 6
	3-Methyl-trans-2- pentene	67 63	-134 84	1 4016	0 6942	dı-	72 415		1 5085		
50	trans-2-Hexene 2-Hexene (cis-trans mixture)	67 87 67 9 8 I	-132 97	1 3935 1 3928	0 6784 0 6813	dı- dı-	90 <sup>16</sup>		1 5025 1 5025	1 5812 1 5812	
	2,3-Hexadiene 2,3-Dimethyl-1,3-	68 68 78	<b>-76 01</b>	1 395 1 4394	0 680 0 7267	dı-		47, lgr			Maleic anh adduct,
	butadiene					tetra-		138, bz			78-9
53 54	diene (1-Isopropyl-	68 84 70	-141 14	1 3977 1 424	0 6869 0 708	dı-	9016		1 5025	1 5812	
55	allene) 3-Methyl-cts-2- pentene	70 45	-138 45	1 4045	0 6986	dı-	72-415		1 5085		

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling point,	Melting point,	n 20	D20		Bro	mine addition	product		Miscellaneous
		°C	°C			x-Bromo-	BP, °C	MP,°C	n 20 D	D20	
56	2-Methyl-2,3-penta- diene (Trimethyl allene)	72		1 425	0 711						
57	1 '	72 3 2 5		1 440219	0 705719	tetra- 2 forms		a) 63 4 b) fp <-50			
58	4,4-Dimethyl-1- pentene	72 49	-136 6	1 3918	0 6827	dı	77-89		1 4970	1 5129	Mercaptosuccinic acid adduct, 119 0
59	1, (cis and/or trans)-3- hexadiene	73		1 438	0 705						
60	2,3-Dimethyl-2-butene	73 21	-74 28	1 4122	0 7080	dı		173 4 121	1	İ	
	2-Ethyl-1,3-butadiene	75	ł	1 445	0 717	1	}			į	}
62		75 2	1	1 4306	0 7796		l				
63		75 8	127	1 4330	0 7802	1	<b>\</b>	}	1	1	
64		76	[	1 446	0 719			•			
65	trans)-3-pentadiene 1,2-Hexadiene	76		1 4282	0 7149	tetra-	130³		1 5850	2 1873	
66	(n-Propylallene) 2-Methyl-1,(cis and/or	76		1 446	0 719						
67	,	76 3		1 451	0 719						
68	diene 4,4-Dimethyl- <i>trans</i> -2- pentene	76 75	-115 24	1 3982	0 6889	dı-	92 8- 93 <sup>14</sup>		1 5080	1 5538	
69	3,3-Dimethyl-I- pentene	77 54	-134 3	1 3984	0 6974	dı-	95 3 610		1 5109	1 5615	
70	2,3,3-Trimethyl-1- butene	77 87	-109 85	1 4029	0 7050	dı-	98-914	38-9			
71	3-Methyl-1,3-penta- diene	780 3		1 4494	0 7499						
	trans-1,3,5-Hexatriene	77 8 5		1 4884 13 5	0 74229 15	hexa-		78			
	cis-1,3,5-Hexatriene	78 5		1 4577	0 7179	1					
74	diene	79 70		1 425	0 715		_				
75	2,4-Hexadiene	79 4 81 6 <sup>765</sup>	_ <del>7</del> 9	1 4493	0 7152	2,5-di- tetra-	8511	182	1 53419	1 62219	Maleic anh adduct, 95 6, lgr, SO <sub>2</sub> adduct, 43-3 5
76	3-Methyl-1,5-hexa- diene	80-1		1 4116	0 7103						
77	4,4-Dimethyl-1,2- pentadiene (tert- Butylallene)	80-3			0 7184						
78	1,3-Cyclohexadiene	80 31 757	-1048	1 4740	0 8413	dı-		68, iso- merizes → m 108			Maleic anh adduct, 145-6, heptane, Benzoquinone
						tetra- 2 forms		1, trans- 2,cis-3, trans-4, 92, 1,cis- 2, trans-			adduct, 196 7, lgr
79	4,4-Dimethyl-cis-2-	80 42	-135 46	1 4024	0 6996	dı-	92 8 3 0 <sup>14</sup>	3, trans- 4, 156	1 5080	1 5538	

<sup>\*</sup> Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point	Melting point	n 20	D20		Вго	mine addition	product		Miscellaneous
	Tvame	°C	°C	"D	D.	x-Bromo-	BP °C	MP °C	n 20	D20	
80	3,4-Dimethyl-1- pentene	81		1 3995	0 701						
81	Cyclohexene	82 97	-103 51	1 44654	0 81096	dı-	101 313		1 5445 19	1 77591"	Mercaptosuccinic acid adduct, 150 15, K MnO₄ oxid → adipic ai 154, 2,4-Dinitrophenylsulfenyl chloride, 117 8 HBr → cyclohexyl bromide, bp 165
82	2,4-Dimethyl-2- pentene	83-4	-127 7	1 4016522	0 695822	dı-	8817		1 5092022 5	1 543122 5	
83	3-Methyl-1-hexene	84 0		1 397	0 695	dı-	84 0- 26		1 5028	1 5248	
84	2,3-Dimethyl-1-	84 26	-134 8	1 4033	0 7051	dı-	72 5-		1 5028	1 5245	
85	pentene 3-Ethyl-1-pentene	85 13	-127 4	1 3980	0 6962	dı-	3 0 <sup>3</sup> 93 5 <sup>15</sup>		1 5006	1 5251	
86		85 31	1274	1 3966	0 6920	dı-	142 6		1 4970	1 5072	
00	2 minut 1 menene	05 5.		1 3300	0 0720	ur-	3 6 101		1 47/0	1 3072	
87	5-Methyl- <i>trans-</i> 2- hexene	86 0		1 400	0 700	dı-	87 810		1 4960	1 5027	
88	2-Methyl-3-hexene	86 0		1 399	0 694	dı-	9619		1 5060	1 5310	
89	2,4-Dimethyl-2,3- pentadiene (Tetra- methylallene)	86 5		1 40039	0 7006						
90	4-Methyl-1-hexene	86 73	141 45	1 4000	0 6985	dı-	94 7- 5 7''		1 4980	1 5027	
91	3,4-Dimethyl-2- pentene	87 0		1 407	0 713	dı-	65 5 6 0		1 5104	1 5400	
92	4-Methyl- <i>cis-</i> 2- hexene	87 37		1 4024	0 6996	dı-	91 2''		1 5045	1 5382	
93	4-Methyl-trans-2- hexene	87 6	-126 5	1 4023	0 6975	dı-	91 211		1 5045	1 5382	
94	3,3-Dimethylcyclo- pentene	88		1 423	0 771						
95	2-Ethyl-3-methyl-1- butene	89		1 410	0 715	dı-	72 5 3 5 <sup>3</sup>		1 5062	1 5261	
96	5-Methyl-cis-2-hexene	91		1 400	0 700	dı-	89 9011		1 4990	1 5152	
97	5-Methyl-1,4-hexa- diene	91-25		1 4390	0 7258	1,2-di-	101 418		1 523316	1 56616	
98	2-Methyl-1-hexene	92 0	- 102 84	1 4034	0 7030	dı-	100 5 1 5 <sup>23</sup>		1 5000	1 5066	
99	1,3-Dimethylcyclo- pentene	92		1 428	0 766						
100	2-Methyl-1,5-hexa- diene	92 5769		J 423/6 <sup>17 3</sup>	0 7289185						Nitrosochloride, 75 6
101	2,4-Dimethyl-1,3- pentadiene	93	-114	1 4412	0 7368						
102	1,4-Dimethylcyclo- pentene	93 2		1 4283	0 779						
103	-	93 5		1 4107	0 7099						
104	1-Heptene	93 64	-119 03	1 39980	0 69698	dı-	106 213		1 4990	1 5208	Mercaptosuccinic acid adduct 103 4- 9

<sup>\*</sup>Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

_			·								
Νo	Name	Boiling point	Melting	n 20	D2º		Broi	mine addition	product		Miscellaneous
		°C	point °C		-	x Bromo	BP, C	MP,°C	n 20 D	D20	100000000000000000000000000000000000000
105	3-Methyl-trans-2- hexene	94 0		1 410	0 7120	dı-	65 0 5 1 <sup>2</sup>		1 5040	1 5240	
106		94		1 405	0 708	dı-	77 8+		1 4990	1 4929	
107	3-Methyl-cis-3-	95 35		1 4123	0 7132	1	1				
108	hexene	95 41	- 130 35	1 4106	0 7082	dı-	73 0 1*		1 4990	1 5116	
108	2-Methyl-2-hexene trans-3-Heptene	95 67	- 136 63	1 4043	0 6981	di-	105 5		1 5010	1 5153	
						]	6 523				
110	cis-3-Heptene	95 75		1 4059	0 7030	dı-	105 5-		1 5010	1 5153	
	5-Methyl-1,2-hexa-	96		1 428219	0 722519		6 5 23				
111	diene (Isobutylallene)	170		1 4202	0 /223				1	ļ	1
112	3-Ethyl-2-pentene	96 01	1	1 4148	0 7204	dı-	76 0- 4³		1 5090	1 5426	
113	2,3-Dimethyl-2-	97 5	-1183	1 4208	0 7277	dı-	97 915		1 51722	1 54722	
	pentene	07.05	100.40		0.7012	1.				1 5120	
	trans-2-Heptene 3-Ethylcyclopentene	97 95 98 I	– 109 48	1 4045 1 4319	0 7012	dı-	96 212		1 5000	1 5129	
	cis-2-Heptene	98 5		1 406	0 708	dı-	96 212		1 5000	1 5129	
117	5-Methyl-1,3-cyclo-	100 5	}	1 466222 5	0 8252	1	1				
	hexadiene	1 5762		1 4063	0.7070	1.	06		1 6033	1 4056	
118	2,2-Dimethyl-trans- 3-hexene	100 9		1 4063	0 7039	dı-	96 5- 7 0*		1 5032	1 4856	
119	1,4-Heptadiene	101		1 4202	0 7106	dı-	'		1 5734	2 091	
120	2,4,4-Trimethyl-	101 44	-93 48	1 4086	0 7150	1			]		
	1-pentene	101.6			0.7240						
121	3,3-Dimethyl-1,5- hexadiene	101 6		1 4160	0 7249						
122	3,4-Dimethyl-1,5-	101 8	1	1 4211	0 7304						
	hexadiene	<u> </u>				1.					
	'	102 102 5		1 406 1 4049	0 710 0 709	dı-	10919		1 5058	1 5034	
124	5,5-Dimethyl-1- hexene	102 3		1 4047	0 /03	İ					
125	4-Methylcyclohexene	102 74	-1155	1 4414	0 7947	dı-	13040			1 65015	
	3-Methylcyclohexene	104 0		1 4444	0 8010	ĺ					
127	2-Isopropyl-3- methyl-1-butene	104	1	1 4085	0 722	}					
128	3,4,4-Trimethyl-1-	104		1 412	0 719						
	pentene					}					
	T	104		1 404	0 708	1					
	3,3-Dimethyl-1-hexene 5,5-Dimethyl-trans-2-	104 104 1		1 4070 1 4055	0 7140 0 7066						
31	hexene		1	, 7033	7000		] [				
32	2,4,4-Trimethyl-2-	104 91	- 106 33	1 4160	0 7218		]			}	
	pentene			l	0.726		]				
33	3,3,4-Trimethyl-1- pentene	105		1 4144	0 729					]	
34	2,2-Dimethyl-cis-3-	105 4	-1374	1 4099	0 7128						
	hexene					1					
35	I,2-Heptadiene (n-	105 5 6 0		1 43218	0 730618	2,3-di-	108-		1 520018	1 559518	
	Butylallene)	İ			ļ	tetra-	10 <sup>12</sup> , 140 <sup>3</sup>		1 5718	2 0675	
36	1,2-Dimethylcyclo-	105 8	-90 4	1 4448	0 7976	"""	'*'		1. 50	3373	
	pentene	]									
		106	1	1 440	0 798				1.6112	1 6140	
	4,4-Dimethyl-2-hexene 1-Ethylcyclopentene	106 106 3	-1184	1 413 1 4410	0 722 0 7982	dı-	92 34		1 5113	1 5148	
	5,5-Dimethyl-cis-2-	106 9	11104	1 4113	0 7169	-	1 1				
	hexene	1	1	[	İ	]					

Derivative data given in order im p , crystal color, solvent from which crystallized

		Boiling	Melting				Br	omine	addition	product		
No	Name	point °C	point °C	n 20 D	D <sub>4</sub> <sup>20</sup>	x-Bromo-	BP °C	М	P °C	n 20 D	D <sub>4</sub> <sup>20</sup>	Miscellaneous
141	2-Methyl-2,4- hexadiene	107		1 426624	0 7439							
142	2-Methyl-1,3-cyclo- hexadiene	107 8		1 466218	0 8272¦×							
143	3-Methyl-2,4- hexadiene	107 8		1 4614615	0 762517		}					
144	l .	107 2		1 4102	0 7198	dı-	224 5			1 5003	1 4689	
	3-Ethyl-4-methyl-1-	107 5		1 4097	0 7200	<b>"</b>	224 3			1 3003	1 4007	
	pentene										İ	
	2,4-Heptadiene	107 5 8 0		1 4578	0 7384							
147	2,4-Dimethyl-trans-3- hexene	107 6		1 4126	0 7145							
148	Quadricyclene (Quadricyclo [2,2,1,0 <sup>2 6</sup> , 0 <sup>3 5</sup> ]heptane)	108 <sup>740</sup> sl d		1 4804								
149	2,3,4-Trimethyl-1- pentene	108		1 415	0 729							
150	4-Methyl-1,3- hexadiene	108 10		1 4523	0 7558							
151	2,3,3-Trimethyl-1- pentene	108 3	-69	1 4174	0 7352							
152	4,5-Dimethyl-1-	109		1 414	0 728							:
153	hexene 1,5,5-Trimethylcyclo- pentene (Iso-	109754		1 4324	0 7824							Reduces Tollen's reagent on warm-
154	laurolene) 2,4-Dimethyl-cis-3- hexene	109		1 4140	0 7178							ing
155		110		1 4159	0 728			]				
156		110		1 415	0 730							
157	•	110	1	1 413	0 725			•				
		1100	-121	1 4503	0 8102	dı-	100 212					2,4-Dinitrophenyl- sulfenyl chloride,
159	2-Ethyl-4-methyl-1- pentene	110 3		1 4105	0 7195							139 40
160	•	110 3		1 407	0 715							
	2,3-Dimethyl-1-hexene			1 4113	0 7214							
162	2,4-Dimethyl-2-hexene	1106		1 4118	0 7213			1		!	l	
		111		1 406	0 711			1				
		111 2		1 4110	0 720			1				
		111 6 112		1 4105 1 418	0 7172 0 7305							
167	pentene 3,4-Dimethyl-1-hexene	112		1 413	0 724							
	3,4,4-Trimethyl-2-	112		1 4232	0 7395							
160	pentene 3,5-Dimethyl-2-hexene	112		1 416	0 725							
		112		1 402	0 706			1				
	•	112		1 410	0 713							
	2,5-Dimethyl-2-hexene			1 4140	0 720	dı-	8813			1 4740	1 3980	
	•	112 5		1 423022 5						-		
174		112 5		1 4142	0 729							

<sup>\*</sup> Derivative data given in order mp, crystal color, solvent from which crystallized

		Boiling	Melting				Bro	mine addition	product		
No	Name	point °C	point °C	n 20 D	D <sub>4</sub> ™	x-Bromo-	BP, °C	MP °C	n 20 D	D <sub>4</sub> 90	Miscellaneous
175	4-Methyl-1-heptene	112 8		1 410	0 717						
176	6-Methyl-3-heptene	113734		1 4114	0 7256	dı-		97			
177	4-Ethyl-1-hexene	113		1 412	0 726			1			
178	4-Ethyl-2-hexene	113		1 412	0 725	İ					
179		113	Į.	1 414	0 725	Į.				1	
180	5-Methyl-1-heptene	113 3		1 4094	0 7164						
181	4-Methyl-2-heptene	113 5 4 1	1	1 4096	0 7154				-	1	
	2,3-Dimethyl-3-hexene	•		1 416	0 728				ł		
183	4-Methyl-2-octene	114	1	1 410025	0 718825					1	
184	1	114-5		1 4545716 5	0 763516 5					1	
104	hexadiene	114-5		1 75757	0 7033	ŀ					ļ
185	•	114 6	Ī	1 439725	0 704125						İ
103	heptadiene	114 0		1 4377	0 7041						
186	3-Ethyl-4-methyl-	114 3		1 4210	0 7350						
100	trans-2-pentene	1117		1. 42.0	0 7330					1	
187	Cycloheptene	114 38	- 56	1 4580	0 8254	dı-	unstable			1	Nitrosochloride,
107	(Suberene)	1.17.50	~~		3 3 2 3 7	1"			ļ		118 Oxid →
	(Suborono)	1					]		]		pimelic ac , 105
188	1-Methyl-1,4-cyclo-	114 5-4 8	< - 70	r 4703	0 848	tetra-		171			piniene ac , 103
100	hexadiene	1114 3-4 6	-10	1 4703	0 040	100,00		* * * *			
180	3-Ethyl-4-methyl-cis-	115		1 424	0 739	ļ					
107	2-pentene	'''		1. 727	0 /3/	1	İ				
	2-pentene										
						1					
101	1,3,5-Cycloheptatriene	1155	- 79 49	1 5243							Maleic anh adduct,
171	(Tropilidene)	,	'''			1					104 2-5 0, <b>C</b> Cl <sub>4</sub>
192	3,4-Dimethyl-2-hexene	116	ł	1 418	0 737	1				1	10.200,000,
193	,	116		1 418	0 729	ļ				]	
	6-Methyl-1,3-	116 8	Į.	'''	0 74122	1		ļ		1	
1,74	heptadiene							ŀ		1	
105	2,5-Dimethyl-1,3-	116 8	> - 80	1 45024	0 7412	ļ	•	}			
1/3	hexadiene	110 0		13021	"	]					
196	2,3,4-Trimethyl-2-	116 3	-1133	1 4275	0 7434						
170	pentene	1103	11.55					Ì			
197	4,4-Dimethylcyclo-	116 98	-80 5	1 4420	0 7996	1	ŀ	}	1		1
.,,	hexene	,	1 000		• ,,,,						
198		117		1 412	0 718						
199	2-n-Propyl-1-pentene	1177		1 4136	0 7240					1	
200	5-Methyl-2-heptene	118		1 414	0 723	Ì					
	3,3-Dimethylcyclo-	119		1 445	0 804						
201	hexene	117	1	1 443	0 004			1	[		
202	2-Methyl-1-heptene	119 22	-87 38	1 41195	0 72025						
	1	119 22	solid at	1	0 7637			1			
203	2,5-Dimethyl-1,5- hexadiene	119 23	<b>5</b>	1 45054	0 /03/				Ì		
	HEXAUTER		-80, liq at -23			1					
204	2 Ethul 1 havana	120	at -23	1 4157	0.7270				:		Margantaguagana
204	2-Ethyl-1-hexene	120		1 4157	0 7270						Mercaptosuccinic
					}	1				1	acid adduct,
205	d 1-1,2,3-Trimethyl-	130 175		1. 4431	0.7050					1	101 9-2 7
205		120 1752		1 4421	0 7950						
	cyclopentene	}								1	
201	(Laurolene)	120.4		1 417.32	0.742.00	1			1	1	
	4-Methyl-3-heptene	120 4		1 4171225	0 741125	l			[	l	
	3-Ethyl-2-hexene	121		1 424	0 737		Ì	i		1	
		121		1 418	0 728	1.			l	1	1
209	1-Octene	121 28	- 101 76	1 40870	0 71492	dı-	240 2,		1 4970	1 4580	Mercaptosuccinic
		1					118 515			1	acid adduct,
											961-6

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

<u> </u>	N	Boiling	Melting		D 10		1	Bro	mine ado	lition	product		Manalla
No	Name	point °C	point °C	n 20	D <sub>4</sub> 0	x Bromo	ВР	С	МР	С	n 20 D	D <sub>4</sub> 20	Miscellaneous
210	trans-4-Octene	121 4739	fp -94	1 41157	0 71467	di (meso)	1038				1 496724	1 4525	
211	1,3-Cycloheptadiene (Hydrotropilidene)	121 52	-110 42		0 8929?	(MCSO)	E						H <sub>2</sub> → Cyclo heptane b p 118 20
212		121 6		1 4183	0 7296			,					110 20
213	cis-4-Octene	121 7739	fp -118	1 41361	0 72048	di (d l)	84 0 8 4 <sup>4</sup>	3			1 4981	1 4569	
214 215		121 8 122	-1151	1 4268 1 430	0 7408	dı	85 75				1 5060	1 387	
216		122 4 113 5		1 4070	0 7125								
217	cis-3-Octene	122 3741	fp -126	1 41246	0 71888						İ		
218	trans-3-Octene	122 4741	f p -1104	1 41241	0 71630								
219 220	2-Methyl-2-heptene trans-2-Octene	123 5 125 0	-87 7	1 4138	0 7241								Mercaptosuccinic
220	trans-2-Octene	1230	-011	1 4132	0 /199								acid adduct
221	cis-2-Octene	125 64	-100 2	1 4150	0 7243								142933
222	2-Methyl-1,3-hepta- diene	127 8 4		1 4432	0 7432								
223	1,4-Dimethylcyclo- hexene	128		1 446	0 802								Nitrosochloride 83 4
224	1,5-Dimethylcyclo- hexene	128		1 448	0 8051								Nitrosochloride
225	2,6-Dimethyl 2- heptene	128 9		1 412	0 722								
226	4-Vinylcyclohexene	129 5 30 5 36 <sup>23</sup>		1 4623	0 8320	αβ dı			69 5 7 eth	0			
227	4-Methyl-2,4-hepta- diene	131 2		1 4621	0 7551								
228	3,4-Dimethyl-2,4- hexadiene	132 4 71 3		1 4410	0 7832								
229	3-Methyl-2,4-hepta- diene	132 5		1 4649	0 7667								HBr → Dihydro bromide b p
												ŀ	109 11 6
230	Bicyclo[4,2,0]oct-7-ene 4-Ethylcyclohexene	132 5		1 4761 1 449	0 810	dı	74°						
232	1,6-Dimethylcyclo-	133		1 454	0 815								
233	hexene 3,5-Dimethyl-2,4-	133 44 +		1 4487	0 7728								
234	heptadiene 2.4-Octadiene	133 5 4 0		1 45422	0 7427 2								
	2,5-Dimethyl-2,4-	133 6 281	1468	1 479619	0 7646 *	tetra			101				Oxid in air → poly
	hexadiene				<b> </b>								meric peroxide 59
236	3-Ethylcyclohexene 1,2,3,3-Tetramethyl-	134 134 5		1 451 1 44406	0 814 0 8035								
-31	cyclopentene (Campholene)	.5. 5		. 77700	3 0033								
238	1-Ethylcyclohexene	136		1 4575	0 823								
239	1,2-Dimethylcyclo-	137		1 4588	0 8250	dı		١	142 3				Nitrosochloride
240	hexene 1,3-Dimethylcyclo-	137		1 445	0 802				acet				58 60
	hexene												
241	Bicyclo[4,2,0]oct-2-ene	137 9		1 481030	0 8948								

<sup>\*</sup>Derivative data given in order m p crystal color solvent from which crystallized

		Boiling	Melting			T	Brot	nine addition	product		
No	Name	point, °C	point *C	n <sup>™</sup> D	D‡º	x Bromo	BP °C	MP 'C	n 20 D	D <sup>20</sup>	Miscellaneous
243	1-Methylcycloheptene	137 5 8 5		1 4581	0 8243**						Nitrosochloride, 106, Nitrosate, 97 8
	2-Methyl-4-octene	138733		1 4181	0 7392						
245	δ-Fenchene (1,5 5-Tri- methylbicyclo[2,2,1] hept-2-ene)	139 40		1 44862	0 8433						Nitrosochloride, 131
246	1,5,5-Trimethyleyclo- hexene (α-Cyclo- geraniolene)	139-41 34		1 4461221	0 798123						Nitrosochloride, 100 20, ag me , al Nitrosate, 102 4
247	2,6-Dimethyl-2,4- heptadiene	139 437 2		1 458744	0 74820						
248	1,4,4-Trimethylcyclo- hexene (Pulenene)	139 5-40 5		1 444252	0 8032 15 5	dı-	120 0 5 111		1 524711	1 532417	Nitrosochloride, 118-22, et ac
249	1,5,6-Trimethylcyclo- hexene	140		1 4572	0 831 25						
250	2,3-Dimethyl-2-nor- bornene (Santene 2,3-Dimethylbicyclo [2,2,1]-hept-2-ene)	140-1, 35 <sup>1</sup>		1 46699	0 8640						Dichloride 88 9, Nitrosate, 216d, Nitrosochloride, 109 10 Nitrosite, 3 forms a) 122 4, bl b) 127-8, grn, c) 104, col
251	2,6-Dimethyl-1,3- heptadiene (Iso- geraniolene)	140-2, 31		1 460624	0 792322				i		
252		140 56 142 3, 42 2 51	- <b>4</b> 68, -7	1 5290	0 9206						Maleic anh adduct, 167 8 Benzo- quinone adduct, 141, al Acrylic ac adduct 112 3, Igr AgNO, adduct, 173 4
	7-Methyl-3-octene 2,6-Dimethyl-1,5- heptadiene (Geraniolene)	141 <sup>746</sup> 141-2, 165 70	<b>-70</b>	1 4168	0 7278 0 762622						
	1,8-Nonadiene •	141-4		1 4302	0 7511						Nitrosochloride,
256	1,3,5-Trimethylcyclo- hexene (Tetrahydro- mesitylene)	142 5–3 5		1 44913 5	0 802514 3		ļ Ļ				134
257	3-Methyl-2-octene	143-5734		1 4247	0 740925			•			D Daggle
İ	Cyclooctene	143 8-		1 4693							Br <sub>2</sub> → Bromocyclo- octene, b p 7-8 <sup>23</sup> , $n_D^{20}$ 1 5182, D1- chloride, b p 130 4-0 6 <sup>25</sup> , m p -5, $n_D^{20}$ 1 5061, $D_4^{20}$ 1 1620
259 260	3,6-Dimethyl-2,4- heptadiene 4-Nonene	144-6,		1 4633514	0 7853°	dı-	119		1 498817	1 41017	
	1,4,5-Trimethylcyclo- hexene	144-6, 44 6 <sup>12</sup> 144-6		1 4482	0 805		2012				

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling	Melting	_ 20	D20		Bro	mine addition	product		Miscellaneous
NO	Name	point, °C	point, °C	n 20 D	D <sub>4</sub> <sup>20</sup>	x-Bromo-	BP,°C	MP,°C	n 20 D	D <sub>4</sub> <sup>20</sup>	Miscellaneous
262	1-Vinylcyclohexene	145, 63 5 <sup>53</sup>		1 495019							50% H <sub>2</sub> SO <sub>4</sub> → dimer, b p 118-9 <sup>5</sup>
263 264	cts-1,4-Cyclooctadiene 1,3,5-Cyclooctatriene	145 1 <sup>758</sup> 145 6, 76 <sup>90</sup>	-53	1 503525	0 8754 0 8971 <sup>25</sup>	tetra-		139			Maleic anh adduct, 144-5, AgNO <sub>3</sub> adduct, 125-6, al
265	4,4-Dimethyl-1,7- octadiene	145 8		1 4330	0 7647						
266	ξ-Fenchene (2,7,7-Tri- methylbicyclo[2,2,1] hept-2-ene)	146 2 6 8 <sup>752</sup>		1 4865	0 8626						$[\alpha]_{\mathbf{D}}^{20}$ -24 1
267	1,6,6-Trimethylcyclo- hexene	146 2- 7 2 <sup>767</sup> , 144 6		1 456204	0 8217203						Nitrosochloride, 133 4, et ac
268		146 87	-81 37	1 41572		dı-	141 520		1 4942	1 3980	
269 270		147 4 <sup>750</sup> 148 9		1 4173 1 4905	0 7294 0 8818 <sup>24</sup>	The second secon					N-Bromosuccini- mide → bromo- cyclooctadiene, b p 6419, n <sup>25</sup> 1 5410, D <sup>25</sup> 1 3420
271	4-Methyl-3,5-octa- diene	148 51		1 4628525	0 764025						
272	7-Methyl-2,4-octa- diene	149		1 454318	0 752118	tetra-	18418				
273	1-Ethyl-4-methyl- cyclohexene	149, 153 4		1 45316	0 816916						Nitrosochloride, 2 forms a) 103-4, pr, eth, b) 98 9, cr, eth
274	1-Ethyl-3-methyl- cyclohexene	149 51		1 454	0 8296						
		149 4 9 9		1 42021	0 73821						
J	1,2,3-Trimethylcyclo- hexene	149 6 150 <sup>749</sup>		1 46312	0 834712						
2//	1-Ethyl-5-methyl- cyclohexene	150		1 452725	0 81225						
278	β-Fenchene (2,2 D1- methyl-5-methylene- bicyclo[2,2,1] heptane)	150 5 3 5		1 46511	0 8599	dı-		81-2			[α] <sup>25</sup> +62 5, Nitrosochloride, 120
279	2,6-Dimethyl-2,5- heptadiene	150610		1 4490							
	2,7-Nonadiene	150 6	-72 5	1 4358	0 7499	,	143 410			1 6370	
281	Allylcyclohexane (3- Cyclohexylpropene)	151		1 453613	0 819613	dı-	143 416			1 537°	
282	1-Ethylidene-4-methyl- cyclohexane	152-3		1 457121	0 8121						Nitrosochloride, 2 forms a) 117-8, least soluble, b) 113-4, more soluble
283	4,5-Dimethyl-2,6- octadiene	152 9-3 8		1 437525	0 761125						115 -, more solution
284	1-Ethylidene-3- methylcyclohexane	153		1 4584	0 813519						Nitrosochloride,
285	3,6-Dimethyl-2,6- octadiene	153-5		1 44453	0 7767						114, acci
286		155 6720		1 438518	0 760518						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		Boiling	Melting	. 20	D <sub>20</sub>		Bro	mine addition	product		Missellan
No	Name	point, °C	point, °C	n <sub>D</sub> <sup>20</sup>	Di	x Bromo	BP,°C	MP,°C	u D	D20	Miscellaneous
287	α-Pinene	156 0-6 3	- 50	1 4560	0 8600	dı-		169 70, al			Nitrosochloride, 109, Hydro- bromide, 89, Nitrosobromide, 91 2d, Acid KMnO <sub>4</sub> → pinonic ac, 103-5
288	1-Ethylidene-2- methylcyclohexane	158		1 47	0 8230					ļ	ac, 103 3
289	2,4-Dimethyl-2,4- octadiene	161 3746		1 455898	0 78029 8		]				
290	1,4,4-Trimethylcyclo- heptene (Eucarvene)	161-5720		1 4561	0 8185						
291	β-Pinene (Nopinene, Pseudopinene)	163-4		1 4782	0 8694				,	1	$[\alpha]_{\mathbf{D}}$ -22
292	2,7-Dimethyl-2,6- octadiene	163 5 4 5		1 44814	0 7849	tetra-		124-7			
293	3,7-Dimethyl-2,4- octadiene	164-7, 58 <sup>12</sup>		1 456	0 7933						
294		165 5 7 0 <sup>707</sup>		1 47430	0 855230						$[\alpha]_{D}^{30}$ +62 2
295	• '	166		1 4722	0 7982						Maleic anh adduct, 33-4, 1,4-Naph- thoquinone adduct, 81
296	2,6-Dimethyl-2,6- octadiene	168, 5614		1 4524515	0 77521					[	Methiodide, 130d
297	/-3-Carene (3,7,7-Tri- methylbicyclo[2,2,1]- hepi-3-ene)	168 9 <sup>705</sup> , 123 4 <sup>200</sup>		1 46930	0 858630						[α] <sup>30</sup> +7 69, Nitrosochloride,
298	3,8-o-Menthadiene (cis-3-Isopropenyl- 4-methylcyclo- hexene)	169-70		1 4749	0 8507						
299	5-Decene	170750	-112 to	1 4260	0 7474	dı-	119°		1 4912	1 3484	
300	p-8-Menthene (1-Iso propenyl-4-methyl- cyclohexane)	170		1 4523	0 8142						
301	d-m-8-Menthene (1- Isopropenyl-3- methylcyclohexane)	170		1 4546	0 8179						[α] <sub>D</sub> +9 73
302	I-m-8-Menthene (1- Isopropenyl-3-	170-1		1 4574	0 8189						[α] <sub>D</sub> -8 06
303	methylcyclonexane) 6,8-o-Menthadiene (3- Isopropenyl-2-	170 1		1 4758	0 8481						
304	Isopropenyl-3-	170–1		1 4778	0 8490\;						
305	methylcyclohexene) 1-Decene	170 57	-66 31	1 42146	0 74081	dı-	145 16018		1 489124	1 32428	Mercaptosuccinic acid adduct,
306	4-Decene	170 6		1 4243	0 7404						93 5- 8

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point	Melting point,	n 20	D³⁰		Bro	mine addition	product		Miscellaneous
NO	Name	*C	°C	n 20 D	D.	x-Bromo-	BP, C	MP, C	n 20	D2º	Miscelaneous
307	p-Menthene (1-Iso- propylidene-4- methylcyclohexane)	172-4		1 4568	0 81921						Nitrosochloride, 101-3
308	1-Isopropenyl-1,4-	172-6		1 5216	0 9068	tetra-		113			
309	cyclohexadiene o-Menthene (1-Iso- propylidene-2-	173, 160-2		1 467	0 8345						
310	methylcyclohexane) m-Menthene (1-lso- propylidene-3- methylcyclohexane)	173-5		1 4670	0 8214						
311		173 5 4 8 <sup>755</sup>		1 477	0 8375						Dihydrochloride, 53-4, me al, Di- hydrobromide, 58 9, me al, Di- hydroiodide, 76, me al, Nitrosite, 155, Maleic anh adduct, 62, 66-7
312	2,4-p-Menthadiene(2- Isopropyl-5-methyl- 1,3-cyclohexadiene)	174 6		1 484527	0 844127					į	
313	/-5-Isopropyl-2- methyl-1,3-cyclo- hexadiene	174-7	·	1 4732	0 8425						[ $\alpha$ ] <sup>20</sup> = 112.76, Nitrosite, $\alpha$ 120–1, $\beta$ 105.6
314	1,5-p-Menthadiene (5-Isopropyl-2- methyl-1,3-cyclo- hexadiene)	175 6		1 4777	0 846325						[α] <sub>D</sub> +49 1, Nitro- site, α 113-4, β 105 Maleic anh adduct, 126-7, pet eth
315	d-Silvestrene	175 8		1 4760	0 8479	tetra-		135			Dihydrochloride, 72, Nitrosochlo- ride, 106-7
316	d-Limonene	176 6 4		1 4743	0 8411	tetra-		104			Nitrosochloride, 100-4, 2,4-Dinitro- phenylsulfenyl chloride, 195-6
317	Isocarvestrene (5-Iso- propenyl-1-methyl- cyclohexene)	176 7765		1 4804	0 8496	tetra-		137-8, me al -chl			Dihydrochloride, 71 5, me al
318	l-3-Isopropenvl-1- methylcyclohexene	176–8		1 476118	0 84819						[α] <sup>18</sup> -68 2, Di- hydrochloride, 72
319		177 6-8 0		1 472720	0 840220	tetra-		125, eth			Dihydrochloride, 50-1, al
320	3,8-m-Menthadiene (1-Isopropenyl-5- methylcyclohexene)	179730		1 4972							$[\alpha]_D$ +175
321		180 1769		1 5005	0 8672	dı-		115			
322	·	183		1 476514 5	0 849	tetra-		129-30, pet eth			$[\alpha]_{b}^{25}$ +36, Nitrosochloride, 111, Nitrosate, 116d, ac a -me al
323	d 1-2,8-m-Menthadiene (1-Isopropenyl-3- methylcyclohexene)	184 7		1 503	0 86420						

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

<b>.</b>	N	Boiling	Melting	- 20	D20		Bro	mine addition	product		
No	Name	point, °C	point, °C	n 20	D20	x-Bromo	BP °C	MP °C	n 20 D	D20	Miscellaneous
	propylidene-6-methyl cyclohexene			1 5026	0 8624						Nitrosite, 155, me al or chl, Maleic anh adduct, 205 8
325	Terpinolene (4-Iso- propylidene-I methylcyclohexene)	186		1 4883	0 863315	di- tetra- 2 forms		69 70 a) 119, ac a, b) 122			Maleic anh adduct, 182
326	2-Undecene (2- Hendecene)	192 3, 78 5 <sup>14</sup>		1 43325	0 773515	dı-	145 69	,			
327	5-Undecene (5- Hendecene)	192 2		1 4289	0 7511		Ì				
328	1-Undecene (1-Undecene)	192 67	-49 19	1 42609	0 75032	dı-	18623		1 4916	1 3122	
329	cis-Cyclodecene	194 5740		1 4854	0 8770	dı-	<u> </u>	121			O <sub>3</sub> → Sebacic acid, 134 5
330		213 36 88 7 <sup>10</sup>	-35 23	1 43002	0 75836	dı-	į	-15			
331	1-Tridecene	232 78 104 5 <sup>10</sup>	-23 07	1 4336	0 7653						
332	1-Tetradecene	251 1, 119 0 <sup>10</sup>	12 85	1 43631	0 7713	dı-		0			Mercaptosuccinic acid adduct, 104 0 8
333	Cedrene	262-3, 124 6 <sup>12</sup>		1 500119	0 9359 5						
334	1-Pentadecene	268 17, 133 7 <sup>10</sup>	-3 73	1 4389	0 77641	dı-	204-517	į	1 4897	1 2235	
335	1-Hexadecene	284 4 103 9 <sup>1</sup>	4 12	1 44120	0 78112	dı-	225 715	13 5, al			1% Hot KMnO <sub>4</sub> → n pentadecylic ac, 52 3, Mercaptosuccinic acid adduct, 105 0 8
	•	299 7, 116 <sup>1</sup> 314, 277 <sup>100</sup>		1 4432	0 7852 0 7953	dı-	267-8 <sup>28</sup>				330, 103 0 0
338		314 2, 1281	176	1 4449	0 7888	dı-		24, al			

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

a) Liquids 2) (B.p. at reduced pressure only. Listed alphabetically)

No	Name	Boiling point, °C	Melting point, *C	п <mark>20</mark>	D₹º	Miscellaneous
1	Bicyclo[12,2,2]octadeca-14,16,18-triene	163 5 4 55 5		1 520425		Maleic anh adduct, 143 4
2	Bicyclo[4,2,0]oct-3-ene	81140		1 4832		
3	Butylcyclooctatetraene	9820		1 508325	0 887625	
4	trans-Cyclodecene	68-7010		1 4822	0 8672	O <sub>3</sub> → Sebacic acid, 134 5
5	1,5,9,13-Cyclohexadecatetraene	93 8º 8	1	1 5472		
6	trans-Cyclononene	73 430	ŀ	1 4799	0 8615	Phenylazide adduct, 97 8 8 2
7	1,3-Cyclooctadecadiene	115³		1 4899	0 8814	•
8	1,3-Cyclooctadiene	4825	-57 to -55	1 494025	0 869925	
9	1,3,6-Cyclooctatriene	6860	-62 to -56		0 894025	
10	1,3-Cyclotetradecadiene	106-83		1 4982	0 872325	Nitrosochloride, 109-10, Nitrosate, 210d
11	1,2-Dimethylcyclooctatetraene	107%		1 521925	0 895025	Maleic anh adduct, 184 5-5 5, bz -lgr , AgNO <sub>3</sub> adduct, 142 5 4 5, al
12	2,6-Dimethyl-2,5-octadiene	59 0- 512		1 4500	0 733	
13	Ethylcyclooctatetraene	813"		1 518725	0 899625	Maleic anh adduct, 97 8 5, bz -cyclohexane, AgNO <sub>3</sub> adduct, 124-5 5, al
14	5-Methylcycloheptene	69 7038	1	1 4201631	0 7606131	
15	Methylcyclooctatetraene	84 567	1	1 524925	0 897825	
16	7-Pentadecene	11432	ł	1 4420	0 7765	
17	Propylcyclooctatetraene	739	1	1 513125	0 887025	

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point *C	Boiling point, °C	n <sub>D</sub>	D <sub>2</sub> º	Bromine addition product					N
						x Bromo	Вр,℃	Мр	C n <sub>D</sub> <sup>2</sup>	Di	Miscellaneous
1	1-Nonadecene	23 4	328 0,	1 4445	0 7886						
			138 81					ŀ	1		İ
2	Eicosene	28 6	341 2	1 443930	0 788230	Į.	1	1	-	-	ļ
3	Bicyclo[4,7]pentadiene (endo-4,7-	32	170	1 507025	0 976633					i	Phenylazide adduct,
	Methylene-4,7,8,9-tetrahydroindene)	ļ	1				j	1		j	128
4	1-Heneicosene	33 3	355		0 7977 <sup>8</sup>	1	1		1	- 1	
5	1-Docosene	37 8		1 4505 <sup>s</sup>	0 8002 s						
6	1-Tricosene	416	379	1 4516 <sup>8</sup>	0 8023 s				1		
7	1-Tetracosene	45 3	390	1 4527 <sup>s</sup>	0 8045 <sup>8</sup>	1			1	1	
8	1-Pentacosene	48 7	401	1 4536 <sup>s</sup>	0 8063 <sup>8</sup>					j	
9	cis cis cis 1,4,7-Cyclononatriene	49 5-50	l	ŀ		İ				- 1	AgNO <sub>3</sub> adduct, 243d
10	d,l-Camphene (2,2-Dimethyl-3- methylenebicyclo[2,2,1]heptene)	50	159 60			dı-	91-2	153 51			
11	l-Camphene	51 3	159-60								2,4-Dinitrophenyl- sulfenyl chloride, 121 2, Hydrochlo- ride, 125-7
12	1-Heptacosene	54 7	421	1 4552 <sup>s</sup>	0 8097 <sup>8</sup>				1	1	1100, 125-7
13	1-Triacontene	62 4	448		0 8141 <sup>8</sup>				1	-	
14	1-Hentriacontene	64 6	457	1 4580 <sup>s</sup>	0 8153 <sup>8</sup>				1	1	
15	1-Dotriacontene	66 7	465	1 4585 <sup>8</sup>	0 8165 <sup>8</sup>		} }		1		
16	1-Tritriacontene	68 7	473	1 4591 s	08176 <sup>s</sup>						
17	1-Tetratriacontene	70 5	481	1 4596 <sup>8</sup>	0 8186 <sup>s</sup>						i
18	1-Pentatriacontene	72 3	489	1 4601 s	0 8196 <sup>8</sup>				1		<u> </u>
19	1-Hexatriacontene	73 9	496	1 4605 <sup>8</sup>	0 8205 s						[
20	1-Heptatriacontene	75 5	503	1 4610 <sup>s</sup>	0 8214 <sup>8</sup>					1	
21	1-Octatriacontene	77	510	1 4614 <sup>8</sup>	0 8223 <sup>s</sup>				1	}	
22	1-Nonatriacontene	78 4	517	1 4618	0 8231 s				1	1	
23	1-Tetracontene	79 8	523	1 4622 <sup>s</sup>	0 8238 <sup>s</sup>						
24	Bicyclo(2,2,2)-oct-2-ene	111 2	128 34			2,3-trans-	1	5505	5	1	Ì
						dı-			ı	ĺ	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

S = Supercooled liquid at 20°

#### EXPLANATIONS AND REFERENCES TO TABLE III

Hg salt (Mercuric acetylide) \*

$$2 \text{ RC}$$
 = CH + K<sub>2</sub>HgI<sub>4</sub> + 2 KOH → (RC = C)<sub>2</sub>Hg + 4 KI + 2 H<sub>2</sub>O

Mercurus salt

From the terminal alkyne and K<sub>2</sub>HgI<sub>4</sub> (prepared from mercuric chloride, potassium iodide and potassium hydroxide)

For directions and examples see Linstead, p 52, J R Johnson and W L McEwen, J Amer Chem Soc, 48, 469 (1926)

Hydration to form carbonyl compound

Terminal acetylenes 
$$RC = CH + H_2O \xrightarrow{H_2SO_4} \begin{array}{c} H_2SO_4 \\ HgSO_4 \end{array} \xrightarrow{RCOCH_3} \begin{array}{c} RCOCH_3 \\ Methyl \ ketone \end{array}$$

Other acetylenes  $RC = CR' + H_2O \xrightarrow{H_2SO_4} \begin{array}{c} RCOCH_2R' + RCH_2COR' \\ Mixture \ of \ ketones \end{array}$ 

From the alkyne in methanol and a catalyst composed of boron trifluoride etherate, red mercuric oxide and trichloroacetic acid

For directions and examples see J G Sharefkin and E M Boghosian, Anal Chem, 33, 640 (1961)

From the alkyne, mercuric sulfate and sulfuric acid in 70% methanol, in 70% acetone or in 60% acetic acid

See Cheronis, p 576, H Erdmann and F Kother, Z Anorg Chem, 18, 48 (1898), R J Thomas, K N Campbell and G F Hennion, J Amer Chem Soc, 60, 718 (1938)

From the alkyne, mercuric oxide and sulfuric acid in alcohol

See J R Johnson, A M Schwartz and T L Jacobs, J Amer Chem Soc, 60, 1882 (1938)

NOTE For directions and examples for the preparation of the semicarbazones and the 2,4-dinitrophenyl-hydrazones of the formed carbonyl compounds see explanations and references to Table IX and X, p 141, 142, 143

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)
a) Liquids (Listed in order of increasing b.p.)\*

						Hydration pro	oduct (RC≡ and its der		OCH₂R )		
No	Name	Boiling point, °C	Melting point, *C	ռ <sup>20</sup>	D <sup>20</sup>	Ketone	Вр,°С	2,4-D1- nitro- phenyl- hydrazone of ketone	Semicar- bazone of ketone	Hg salt	Miscellaneous
1	Ethyne (Acetylene)	-84 0 (sat press)	-80 8, subl		0 6179-*4	(Acetalde- hyde)	(20 2)	(168)	(162-3)		
2	Propyne (Methyl acetylene)	-23 22	-102 7		0 6174-23	Acetone	56	128	190	204	
3	I-Butyne (Ethyl acetylene)	8 09, 8 3	-125 72	1 3962	0 6682*	2-Butanone	82	116-7	135 6	162 3, al	
4	1,3-Butadiyne (Diacetylene)	10 3	-35 to -36	1 4120	0 7249					161 5 20	KOBr → 1,4-Di- bromo deriv, 49 50, bz
5	3-Methyl-1-butyne (Isopropyl acetylene)	26 35, 28	-89 7	1 3723	0 666						Tetrabromo deriv,
6	2-Butyne (Dimethyl acetylene)	27 2 6	-32 26	1 3921	0 6901	2-Butanone	82	116 7	135 6		Tetrabromo deriv , 243, eth , 2,4-Di- nitrophenyl- sulfenyl chloride, 65 6
7	3-Methyl-3-buten-1-yne (Isopropenyl acetylene)	33		1 4158	0 680111	ļ					3,4-Dibromo deriv, b p 50 0-1 510
8	3,3-Dimethyl-1-butyne (tert-Butyl acetylene)	38 9	-81 20	1 3772515	0 673715					92 5-3 0	Cu salt, 140, red
9	1-Pentyne (Propyl acetylene)	40 18	-105 7	1 3852	0 6901	2 Pentanone	102 3	145	112, 106	118 4	Tetrabromo deriv,
10	1-Penten-4-yne (Allyl acetylene)	42-3		1 412516	0 73816	Allyl methyl ketone	111 2	160			1,2-Dibromo deriv, b p 79 5 80 5 <sup>10</sup> , 4,4,5,5-Tetrabromo deriv, b p 132 6 <sup>10</sup>
11	cis-3-Penten-1-yne (cis-Propenyl acetylene)	44 6		1 4330	}					48	
12	trans-3-penten-1-yne (trans Propenyl acetylene)	52 2		1 4377	0 7270					155-7	1,2-Dibromo deriv , b p , 60-210, 3,4- Dibromo deriv , 66-7610
13	2-Pentyne (Ethyl methyl acetylene)	56 07	-109 3	1 4039	0 7107	2-Pentanone	102 3	145	112, 106		KMnO <sub>4</sub> → formic ac + propionic ac
14	1-Penten-3-yne (Methyl vinyl acetylene)	59 2 60 1		1 4496	0 7401	3-Pentanone	102	156	138-9		
15	4-Methyl-1-pentyne (Isobutyl acetylene)	61 1 2, 99	105 1	1 3936 a	0 709215					100 0- 5	
16	3-Methyl-1-pentyne (sec-Butyl acetylene)	65 70 <sup>770</sup> , 57 7		1 3916	0 7037					74-5	
17	1-Hexyne (Butyl acetylene)	71 33	-1319	1 3989	0 7155	2-Hexanone	128	106 7	125	9624	
18	4-Methyl-2-pentyne (Isopropyl methyl acetylene)	72 0 5	-110 37	1 407819	0 71619						
	4,4-Dimethyl-1-pentyne 1,3-Pentadiyne	73 5 75 0- 5, 55-6	-45 to	1 4028 1 4431 <sup>21</sup>	0 7154 0 7375 <sup>21</sup>					125 6 5	
	1,4-Hexadiyne 3-Hexyne (Diethyl acetylene)	78-83 81 5 <sup>744</sup>	-51	1 411225	0 825 <sup>9</sup> 0 7263 <sup>25</sup>	3-Hexanone	125	130	112		2,4-Dinitrophenyl- sulfenyl chloride, 65 6

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

# TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES) a) Liquids (Listed in order of increasing b.p.)\* (Continued)

						Hydration pro	oduct (RC≡ and its de		OCH₂R )		
No	Name	Boiling point °C	Melting point °C	n't	D;	Ketone	Bp °C	2 4 Di nitro phenyl hydrazone of ketone	Semicar bazone of ketone	Hg salt	Miscellaneous
23	4,4-Dimethyl-2-pentyne (tert Butyl methyl acetylene)	82 9 3 0		1 4071	0 7176						
24	2-Hexyne (Methyl propyl acetylene)	83 7 4 0	-92	1 4135	0 7317	2 Hexanone	128	106 7	125		
25	1-Hexen-3-yne (Ethyl vinyl acetylene)	85 <sup>758</sup>	A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-	1 4522	0 7492	3 Hexanone	125	130	112		1 2 Dibromo deriv b p 87 0 5" 3 3 4 4 Tetr i bromo deriv b p 140 5010
26	1,5-Hexadien-3-yne (Divinyl acetylene)	85 0	-87 83	1 5045	0 7857						140 30
27		87 53		1 44614	0 76714						1 2 Dibromo deriv b p 93 0 5 <sup>1</sup> 1 2 4 5 Tetra bromo deriv b p 154 5 5 0 <sup>10</sup>
28 29	3-Ethyl-1-pentyne 1,5-Hexadiyne (Dipro pargyl)	87 0 8 5 87 5 8 5 5H 2046	-4 266	1 4102 1 4381 <sup>23</sup>	0 7246 0 79943						
30	2-Hexen-4-yne	88 9		1 4918	0 7710	Aliyi ethvi ketone	74 5 6 590	95 106		] 	
31 32	2-Methyl-3-hexyne 4-Methyl-2-hexyne	95 2 95 94	-116 7 f p -107 63	1 4114 1 4170	0 7263 0 73855						
34	3-Ethyl-3-penten-1-yne 5-Methyl-3-heptyne 1-Heptyne (n Pentyl acetylene)	96 5 98 100 <sup>to</sup> 99 74	-80 9	1 4338 <sup>2</sup> ° 1 4102 1 4087	0 7886 <sup>25</sup> 0 7360 0 7328	2 Heptanone	151 2	89	123 127	61 me	
37	5-Methyl-2-hexyne 8-Methyl-4-nonyne 3-Heptyne (Ethyl propyl acetylene)	102 46 104 5 105 6	-92 91	1 41762 1 4311 1 415	0 73776 0 7681 0 7337	4 Heptanone	144	75	132		
39	2-Heptyne (n Butyl methyl acetylene)	111 5 2 5		1 4230	0 748	2 Heptanone +		89	123 127		
40	2,2,5,5-Tetramethyl- 3-hexyne (D1 tert-butyl acetylene)	111 9746	19 4	1 4055	0 7120	3 Heptanone	148		101		
	1.6-Heptadiyne 1-Octyne (n Hexyl acetylene)	112 30 <sup>26</sup> 126 2	-85 -79 3	1 451' 1 4159	0 8164 <sup>17</sup> 0 7461	2 Octanone	173	64 5 58	124 5	80 4 7	
43	4-Octyne (Dipropyl acetylene)	130 4 6745		1 4226	0 7484					me al	
	3-Octyne (Butyl ethyl acetylene)	131 0- 5		1 4261	0 748						
45	2-Octyne (Hexyl methyl acetylene)	138 0 4		1 4285	0 761	2-Octanone	173	64 5 58	124 5		1
46	4-Nonyne (n Butyl	150 4752		1 429625	0 75725	3-Octanone	169 70 <sup>738</sup>	64 5 57 8	117 0 5 73 4		
	propyl acetylene)	130 4.7		1 4270**	U 131**	4-Nonanone + 5-Nonanone			90		

<sup>\*</sup>Derivative data given in order m p, crystal color solvent from which crystallized

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)
a) Liquids (Listed in order of increasing b.p.)\* (Continued)

						Hydration prod	duct (RC= and its deri		OCH₂R′)		
No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> 20	D₽º	Ketone	Bp,*C	2,4-Di- nitro- phenyl- hydrazone of ketone	Semicar- bazone of ketone	Hg salt	Miscellaneous
47	1-Nonyne (Heptyl	150 8	-50	1 4217	0 7568	2-Nonanone	195 3	55-6	118 20	67 8-8 5, me al	
48	3-Nonyne (Methyl pentyl acetylene)	153 5 <sup>745</sup> , 92 <sup>97</sup>		1 4299	0 7616	3-Nonanone +	187751	55 6	111-2		
49	Cyclooctyne	157 5 8 0 <sup>740</sup>		1 4850	0 868	4-Nonanone	187-8	57-8	73 4		
50	2-Nonyne (Methyl hexyl acetylene)	161	ļ	1 4331	0 769	3-Nonanone	187751	55-6	111 2		
51	1,8-Nonadiyne	162, 55 0- 513	-27 28	1 4490	0 8158	2-Nonanone	195 3	55 6	118 20		
52	I-Decyne (n-Octyl acetylene)	174 0	-44	1 4265	0 7655	2-Decanone	215 5	124	63, 81	80 0- 7	
53	3-Decyne (Ethyl hexyl acetylene)	175-6		1 43321	0 776521	3-Decanone +	211		100 1		
		_				4-Decanone	206 7		51 2		
	5-Decyne (Dibutyl acetylene)	177, 100 <sup>80</sup>	_73	1 4332	0 7688	5-Decanone		60 1 5	57 5-8 0		NaNH₂ at 210° → 1-Decyne, b p 174
55	Cyclononyne	177 8740	- 36 4	1 4890	0 8972	Cyclo- nonanone	mp 34	146	184 5		
	2,7-Nonadiyne	180	4 30	1 4674	0 8332			l. <u>.</u>	l	ļ	
57	1-Undecyne (1-Hende- cyne, Nonyl acetylene)	195, 96 43 <sup>30</sup>	-25	1 4306	0 7728	2-Undeca- none	228	63	122 0- 5	79	
58	Cyclodecyne	203 4 <sup>740</sup> 78 5 <sup>12</sup>		1 4950	0 8975	Cyclo- decanone	100 212		203-5		Ozonolysis → sebacic acid, 134 5
59	6-Dodecyne (Dipentyl acetylene)	209745, 908	<u> </u>	1 438025	0 781625						NaNH₂ → 1- Dodecyne, b p 21:
60	I-Dodecyne (Decyl acetylene)	215 89 09 <sup>10</sup>	19	1 4340	0 7788					8428	
61	1-Tridecyne (n-Undecyl acetylene)	234, 102 9510	-5	1 4371	0 7842						
62	1-Tetradecyne (Dodecyl acetylene)	252, 118 31 <sup>10</sup>	0	1 4396	0 7888						
63	1-Pentadecyne (Tridecyl acetylene)	268 129 79 <sup>10</sup>	10	1 4419	0 7928						
64	1-Hexadecyne (Tetra- decyl acetylene)	284 103 31	15	1 4440	0 7965						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES) b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point C	n <sup>20</sup>	D2º	Miscelianeous
1	1-Heptadecyne	22	299	1 443725	0 7961 25	
2	2,6-Octadiyne	27	6219	1 45321	0 828 <sup>30</sup>	[
3	1-Octadecyne	27	313	1 4474	0 8025	
	•		180			
4	2-Octadecyne	30	184 15		0 8016	
5	1-Nonadecyne	33	327	1 4488 <sup>8</sup>	0 8050 <sup>8</sup>	Hg salt, 96 7
-		i	14415			n-BuOH
6	1-Eicosyne	35	340	1 4501 <sup>s</sup>	0 8073 <sup>s</sup>	
			1531			
7	2-Henercosyne	35 6	180²	1 449940		1
8	1-Henercosyne	41		1 4513 <sup>8</sup>	0 8094 <sup>s</sup>	
9	1-Docosyne	45	363	1 4524 <sup>s</sup>	0 8114 <sup>8</sup>	
10	1-Tricosyne	49	374	1 4534 <sup>8</sup>	0 8131 s	
11	1-Tetracosyne	52	385	1 4544 <sup>8</sup>	0 8148 <sup>8</sup>	
12	1-Pentacosyne	55	395	1 4552 <sup>8</sup>	0 8163 <sup>s</sup>	
13	1-Hexacosyne	57	405	1 456 <sup>8</sup>	0 8177 <sup>8</sup>	
14	1-Heptacosyne	60	415	1 4568 <sup>s</sup>	0 8 1 9 0 s	
15	1-Octacosyne	62	426	1 4575 s	0 8202 <sup>8</sup>	
16	1-Nonacosyne	65	432	1 4581 <sup>8</sup>	0 8213 <sup>8</sup>	1
17	1-Triacontyne	67	441	1 4587 <sup>8</sup>	0 8224 <sup>s</sup>	
18	1-Hentriacontyne	69	449	1 4593 s	0 8234 <sup>s</sup>	
19	1-Dotriacontyne	71	457	1 4598 <sup>s</sup>	0 8243 s	ł
20	1-Tritriacontyne	73	464	1 4603 <sup>s</sup>	0 825 <sup>8</sup>	į.
21	1-Tetratriacontyne	74	472	1 4608 <sup>s</sup>	0 8260 s	
22	1-Pentatriacontyne	76	479	1 4612 <sup>8</sup>	0 8268 s	
23	1-Hexatriacontyne	77	486	1 4617 <sup>8</sup>	0 8275 s	
24	1-Heptatriacontyne	79	493	1 4621 <sup>8</sup>	0 8282 s	
25	1-Octatriacontyne	80	499	1 4625 <sup>8</sup>	0 8289 <sup>S</sup>	
26	1-Nonatriacontyne	82	505	1 4628 <sup>8</sup>	0 8295 <sup>s</sup>	
27	1-Tetracontyne	83	512	1 4632 <sup>8</sup>	0 8301 <sup>s</sup>	
				i	ı	t .

Derivative data given in order m p crystal color solvent from which crystallized

S = supercooled liquid at 20°

#### EXPLANATIONS AND REFERENCES TO TABLE IV

Nitro derivative \*

From the aromatic hydrocarbon with concentrated nitric and sulfuric acids

For directions and examples see Cheronis, p 578 80, Linstead, p 48, 49, Shriner, p 249, Vogel, p 520, Wild, p 24

From the aromatic hydrocarbon with fuming and concentrated nitric acids

See Shriner, p 249, Wild, p 24

From the aromatic hydrocarbon with fuming nitric acid in acetic acid

See Vogel, p 520

From the aromatic hydrocarbon with nitric and sulfuric acids in chloroform

See Vogel, p 580

Acetamido and Benzamido derivatives \*

ArH 
$$\xrightarrow{\text{HNO}_3}$$
 ArNO<sub>2</sub>  $\xrightarrow{\text{Sn/HCl}}$  ArNH<sub>2</sub>  $\xrightarrow{\text{ArNHCOCH}_3}$  + CH<sub>3</sub>COOH

Acetamido derivative

$$C_6H_5COCl \longrightarrow \text{ArNHCOC}_6H_5 + \text{HCl}$$

Benzamido derivative

Nitration of the aromatic hydrocarbon is followed by reduction with tin and hydrochloric acid. The resulting amine is acetylated with acetic anhydride or benzoylated with benzoyl chloride.

For directions and examples see Cheronis, p 581, V L Ipatieff and L A Schmerling, J Amer Chem Soc., 59, 1056 (1937), 60, 1476 (1938), 65, 2470 (1943)

o-Aroylbenzoic acid (product with phthalic anhydride)

From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride in carbon disulfide *For directions and examples see* Cheronis, p 548, Shriner, p 250, Vogel, p 519, Wild, p 28, H W Underwood and W L Walsh, *J Amer Chem Soc*, 57, 940 (1935)

From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride without solvent See G F Lewenz and K T Serijan, J Amer Chem Soc, 75, 4087 (1953)

2,4-Dinitrobenzenesulfenyl chloride derivative (Aryl 2,4-dinitrophenyl sulfide)

ArH + 
$$O_2N$$

S-CI

AlCl<sub>3</sub>
 $O_2N$ 

SAr + HC

Aryl 2,4-dintrophenyl sulfide

From the aromatic hydrocarbon, 2,4-dinitrobenzenesulfenyl chloride and aluminum chloride in 1,2-dichloroethane

For directions and explanations see Cheronis, p 585, C M Buess and N Kharasch, J Amer Chem Soc, 72, 3529 (1950)

Picrate

ArH + 
$$O_2N$$
  $\longrightarrow$  OH  $\rightarrow$  ArH  $\cdot O_2N$   $\longrightarrow$  OH

NO<sub>2</sub>

Picrate NO<sub>2</sub>

(Molecular complex)

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### **EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)**

From the aromatic hydrocarbon and picric acid in alcohol For directions and examples see Linstead, p. 50 Vogel, p. 518, Wild, pp. 29-30 From excess of liquid aromatic hydrocarbon and picric acid without solvent See Wild, pp. 28-9 Baril and Hauber, J. Amer. Chem. Soc., 53, 1087 (1931) From the aromatic hydrocarbon in methanol or in dry benzene. See Cheronis, pp. 582-3

Styphnate

$$ArH + O_2N \longrightarrow OH \longrightarrow ArH \cdot O_2N \longrightarrow OH$$

$$OH \quad NO_2 \qquad OH \quad NO_2$$

$$Styphnate \qquad (Molecular complex)$$

From the aromatic hydrocarbon and styphnic acid (2,4,6-trinitroresorcinol) in acetic acid *For directions and examples see* Vogel, p. 519, W. J. Hickinbottom, *Reactions of Organic Compounds*, 2nd ed., Longmans, Green and Co., London, 1948, p. 76

#### 1,3,5-Trinitrobenzene derivative

ArH + 
$$O_2N$$
  $\longrightarrow$  ArH  $\cdot O_2N$   $\longrightarrow$  NO<sub>2</sub>

NO<sub>2</sub>

NO<sub>2</sub>

1,3,5-Trinitrobenzene molecular complex

From the aromatic hydrocarbon and 1,3,5-trinitrobenzene in alcohol, acetic acid, or benzene For directions and examples see Vogel, p 519

#### 2 4,7-Trinitrofluorenone (TNF) derivative \*

ArH + 
$$O_2N$$
  $O_2$   $O_2N$   $O_2$   $O_2N$   $O_2$   $O$ 

From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in methanol-benzene and ethanol-benzene mixtures

For directions and examples see Cheronis, pp 582 3, M Orchin, J Amer Chem Soc, 68, 1727 (1946), M Orchin, L Reggel and E O Woolfolk, J Amer Chem Soc, 69, 1225 (1947)

From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in glacial acetic acid

See M C Kloetzel and H E Mertel, J Amer Chem Soc, 72, 4786 (1950), M D Soffer and R A Stewart, J Amer Chem Soc, 74, 567 (1952)

From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone without solvent

See D E Laskowski and W C McCrone, Anal Chem, 30, 542 (1958)

Acids from side-chain oxidation

$$ArR \xrightarrow{KMNO_4} ArCOONa \xrightarrow{H^+} ArCOOI$$
Aromatic acid

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

#### **EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)**

From the alkyl-substituted aromatic hydrocarbon with potassium permanganate in sodium hydroxide or sodium carbonate solution

For directions and examples see Cheronis, p 585, 627, Linstead, p 50, Shriner, p 250, Vogel, p 520, Wild, p 26

From the alkyl-substituted aromatic hydrocarbon with sodium bichromate and sulfuric acid See Cheronis, p. 627, Shriner, p. 250, Wild, p. 26

Sulfonamide \*

$$ArH + CISO_3H \rightarrow ArSO_2CI \xrightarrow{NH_3} ArSO_2NH_2$$
Sulfonyl Sulfonamide

From the aromatic hydrocarbon and chlorosulfonic acid in chloroform, followed by aqueous ammonia For directions and examples see Linstead, p 49, Wild, p 27, E H Huntress and F H Carten, J Amer Chem Soc, 62, 511 (1940), E H Huntress and J S Autenrieth, J Amer Chem Soc, 63, 3446 (1941)

From the aromatic hydrocarbon with chlorosulfonic acid without solvent, followed by ammonolysis with dry ammonium carbonate

See Wild, p 27

<sup>\*</sup>Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS a) Liquids. (Listed in order of increasing b.p.)\*

								,			<b>,</b>	· · · · · · · · · · · · · · · · · · ·
No	Name	Boiling point, °C	Melting point, °C	n 20	D <sup>20</sup>	Picrate	1 3 5 Trinitro benzene deriva- tive	Nitro derivative	Acetamido derivative	Phthalic anhy dride deriva- tive	2,4-Di- nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
1	Benzene	80 1	5 5	1 5011	0 87901	84		1,3-di		127	120	Sulfonamide, 156
2	Toluene	1106	05	1.40412	0.06404	00 7		89, 1,3,5 tri 122	. به ۱۵ م	127	102 3	Owd be
2	Totaciic	1100	<b>– 9</b> 5	1 47013	0 86694	88 2, pa yel		2,4-di 70	2,4 <i>-dı</i> 221	137	102 3	Oxid → benzoic acid, 121, Sulfon- amide, 137
3	Ethylbenzene	136 2	- 93 9	1 49594	0 86690	96 6, pa yel		2,4,6- <i>tri</i> 37	2,4-dı 223	122, 128	97	Oxid → benzoic acid, 121, Sulfon- amide, 109
4	1,4-Xylene	138 3	13 26	1 49581	0 86105	90		2,3,5 <i>-tri</i> 139		132, 148	134-5	Oxid → tere- phthalic acid, > 300, subl, Sulfonamide, 147
5	1,3-Xylene	139 1	-47 89	1 49722	0 86417	91		2,4,6- <i>iri</i> 183		126, 142		Oxid → isophthalic acid, 348, h w, Sulfonamide, 137
6	1,2-Xylene	144 4	- 25 18	1 50545	0 88020	88		4,5-di 118		178		Oxid → phthalic acid, 206 8, Sulfonamide, 144
7	Isopropylbenzene (Cumene)	152 4	- 96 04	1 49146	0 86179			2,4,6- <i>tri</i> 109	4-mono 106, 2,4-di 216	133		Oxid → benzoic acid, 121 Sulfon- amide, 106
8	n-Propylbenzene .	159 2	- 99 59	1 49202	0 86204	103		2,4- <i>dı</i> b p 150 <sup>1</sup>	4-mono 96, 2,4-di 208	125		Oxid → benzoic
9	1-Ethyl-3-methylbenzene	161 3	- 96 55	1 49661	0 86455				200			Oxid → isophthalic
10	(m-Ethyltoluene) 1-Ethyl-4-methylbenzene (p-Ethyltoluene)	162 1	- 62 35	1 49500	0 86118							acid, 348, h w Oxid → tere- phthalic acid, > 300, subl
11	1,3,5-Trimethylbenzene (Mesitylene)	164 7	-44 72	1 49937	0 86518	97		2,4 <i>-dı</i> 86, 2,4,6- <i>trı</i> 235		212		Oxid → trimesic acid, 380, Sulfon- amide, 141
12	1-Ethyl-2-methylbenzene (o-Ethyltoluene)	165 2	- 80 83	1 50456	0 88069			233				Oxid → phthalic acid, 206-8
13	tert-Butylbenzene	169 1	- 58 34	1 49266	0 86650			2,4-di 62, 2,4,6-	4-mono 170, 2,4-di		130 1	Oxid → benzoic acid, 121
14	1,2,4-Trimethylbenzene (Pseudocumene)	169 4	- 43 91	1 50484	0 87582	97		tri 124 3,5,6-tri 185	210			Oxid → trimellitic acid, 225-35 d
15	Isobutylbenzene	172 8	-51 53	1 48646	0 85321				4-mono 127 0 7 5		99 100	Oxid → benzoic acid, 121
16	sec-Butylbenzene	173 3	-75 57	1 49020	0 86207			2,4- <i>di</i> b p 161 2 <sup>5</sup>	4-mono 126, 2,6-di		88-9	Oxid → benzoic
17	3-Isopropyl-1-methylbenzene (3-Isopropyltoluene, <i>m</i> -Cymene)	175 1	- 63 75	1 4930	0 8610				192			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point °C	a D 20	D <sup>20</sup>	Picrate	1 3,5 Trinitro- benzene deriva tive	Nitro derivative	Acetamido derivative	Phthalic anhy- dride deriva- tive	2 4-Di nitro- phenyl sulfenyl chloride deriva tive	Miscellaneous
18	1,2,3-Trimethylbenzene	176 08	- 25 41	1 51393	0 89438	90 5						Oxid → hemimel-
19	(Hemimellitene) trans-Propenylbenzene	176 5 7 5	-27 l to -25 9	1 546325	0 902							httic acid, 190 7 d
20	Indane	177	~514	1 5381	0 9645				,			
	4-Isopropyl-1-methylbenzene (4-Isopropyltoluene, 4-Cymene)	177 1	-67 94	1 4909	0 8537			2,6-di 54, 2,3,6 tri 118		123 4		Sulfonamide, 115
22	<b>2-Isopropyl-1-methylbenzene</b> (2 Isopropyltoluene 2-Cymene)	178 35	-7171	1 5006	0 8766			111 110			!	$Br_2 \rightarrow Tetrabromo$ , 59 5 60 5
23	1,3-Diethylbenzene	181 1	İ	1 49552	0 86394			2,4,6- <i>tri</i> 62		114		
24	1-Methyl-3-propylbenzene (m-Propyltoluene)	181 8		1 4936	0 8610						•	
-	Indene	182 4	<b>– 2</b>	1 5764	0 9915	98, yel				'		Acid → polymer
26	n-Butylbenzene	183 27	-88 15	1 48979	0 86013	E			4-mono 105 2,4-di 214	97	72 3	
27	1-Methyl-4-propylbenzene (p-Propyltoiuene)	183 3		1 4919	0 8584							
28	1,2-Diethylbenzene	183 4		1 50346	0 87996							
29	1,4-Diethylbenzene	183 8		1 49483	0 86196							
30	1,3-Dimethyl-5-ethylbenzene	1838	<b>84</b> 4	1 4981	0 8648	l I		2,4,6-trt 117 0 7 6				$Br_2 \rightarrow Tribromo, 89$
31	1-Methyl-2-propylbenzene (o-Propyltoluene)	184 8	- 60 2	1 4998	0 8744							
32	2,2-Dimethyl-1-phenylpropane (Neopentylbenzene)	186		1 4880	0 858	:						
33	1,4-Dimethyl-2-ethylbenzene	186 9	: 	1 5043	0 8772		i	3,5,6- <i>tri</i> 127-8, al	4-mono 142, 2,4-di 181			Sulfonamide, 107-8
1	2-Methylindane	1870		1 5070	0 9034	i						
35	3-Methyl-2-phenylbutane	188	į	1 486	0 8701				4-mono 147 8, 2,4-di 193			4-Benzamido deriv , 141 2
36	1-Methylindane	188 90		1 5274	0 939				i			Heat with Pt at 310-350 → Naph-thalene, 80 3
37	1,3-Dimethyl-4-ethylbenzene	188 4	- 63 0	1 5038	0 8763			2,5,6- <i>tri</i> 127 5 9 0		!		$Br_2 \rightarrow 2,5,6-Tr_1-bromo, 94 5, 81 2$
38	3-tert-Butyl-1-methylbenzene (3-tert-Butyltoluene)	189 3	-41 39	1 4944	0 8657			-				
39	1,2-Dimethyl-4-ethylbenzene	189 55	-671	1 5031	0 8745				į		i	Oxid → trimel- litic acid, 225 35 d
40	1,3-Dimethyl-2-ethylbenzene	190		1 5107	0 8904							Oxid → hemimel- litic acid, 190-7 d

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS
a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1 3 5 Trinitro benzene deriva tive	Nitro derivative	Acetamido derivative	Phthalic anhy dride deriva tive	2 4 Di nitro phenyl sulfenyl chloride deriva tive	Miscellaneous
41	3-Phenylpentane	191		1 4877	0 8649				4-mono 145 6 2 4-di 199 200			4 Benzamido deriv , 154
42	1-Ethyl-3-isopropylbenzene	192		1 4955	0 859				177 200			
	2-Methyl-2-phenylbutane	192 38		1 4934	0 8737				4 mono 142 2 4 di 181			4-Benzamido deriv 112-3
44	4-tert-Butyl-1-methylbenzene (4-tert Butyltoluene)	192 8	- 52 49	1 4918	0 8612			2 6 <i>di</i> 96				
45	1-Ethyl-2-isopropylbenzene	193		1 5080	0 888		1			ł		
46	2-Phenylpentane	193		1 4876	0 8576				4-mono 107 2 4-di 181 2			4-Benzamido 127 8
47	1,2-Dimethyl-3-ethylbenzene	193 9	- 49 5	1 5117	0 8921							Oxid → hemimel- litic acid 190 7 d
48	(3-sec-Butyltoluene)	194		1 490	0 858							
	3-Isobutyl-1-methylbenzene (3-Isobutyltoluene)	194		1 4888	0 8536							
	d-2-Methyl-1-phenylbutane	194		1 4880	0 8617		l					
21	1,3-Dimethyl-5-isopropyl- benzene	194 5 191		1 4955	0 8591		İ				l	Oxid → trimesic acid, 380
52	2-Phenyl-cis-2-butene	194 5		1 540225	0 91912			1		1	81 2	acid, 560
	<b>4-Isobutyl-1-methylbenzene</b> (p Isobutyltoluene)	196		1 4874	0 8517							
	2-sec-Butyl-1-methylbenzene (2-sec Butyltoluene)	196		1 497	0 873							-
	2-Isobutyl-1-methylbenzene (o-Isobutyltoluene)	196		1 4935	0 8649					ŀ		
	1,4-Dimethyl-2-isopropyl- benzene	196 2		1 5010	0 8738							
	I-Ethyl-4-isopropylbenzene d,l-2-Methyl-1-phenylbutane	196 6 197		1 4923 1 486	0 8585 0 859				4-mono 115 6 2 4 di 193 4			4-Benzamido 126
59	1,2,3,5-Tetramethylbenzene (Isodurene)	197 9		1 5125	0 8899			4 6-di 181 157		213		
60	3-Methyl-1-phenylbutane (Isopentylbenzene)	198 9 196		1 4847	0 8558				4-mono 114 2,4-di 215 6			
61	1,3-Dimethył-2-isopropyl- benzene	199		1 509	0 890				0			
62	1,3-Dimethyl-4-isopropyl- benzene	199 1 195		1 5018	0 869							
63	3-Methylindene	199 2		1 5590727	0 9640	76 8,						
		200 198 5		,		or- yel, al						
64	<b>4-</b> sec- <b>Butyl-1-methylbenzene</b> (p-sec-Butyltoluene)	200		1 4932	0 8650	aı						

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

No	Name	Borling point, °C	Melting point °C	n 20	D <sup>20</sup>	Picrate	1 3,5- Trinitro benzene deriva- tive	Nitro derivative	Acetamido derivative	Phthalic anhy- dride deriva- tive	2 4-Di nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
65	2-tert-Butyl-1-methylbenzene (2-tert-Butyltoluene)	200 5		1 5076	0 8897							
66	3,5-Diethyl-1-methylbenzene (3,5-Diethyltoluene)	200 7	-74 12	1 4969	0 8630			2,4,6- <i>tri</i> 106 6 5				
67	2-Butyl-1-methylbenzene (2-Butyltoluene)	201, 208		1 4958	0 8721							
68		201	ŀ	1 4930	0 8607	ľ	İ				l	
69		201 8	<b> </b> 	1 4993	0 8699							
71	1,2-Dimethyl-3-isopropyl- benzene	202 6	  -  -	1 508	0 888	:						
72	1-Ethyl-2-propylbenzene	203	}	1 4992	0 8744	İ						
73	1,3-Di-isopropylbenzene	203 2	-63 l	1 4883	0 85593			4,6 <i>-di</i> 76 9 7 2, 2-ProH				
	1,2-Diethyl-4-methylbenzene	203 6		1 5039	0 8762			ĺ			1	
i	1,2-Di-isopropylbenzene	203 8	)	1 4960	0 8771	Ì		)	1		1	
76	1,4-Dimethyl-2-propyl- benzene	204 3		1 4999	0 8717							
77	1,2,3,4-Tetramethylbenzene (Prehnitene)	205 0	-63	1 5201	0 9053	92-5		5,6-di 176				
78		205	[	1 4921	0 8594	1	ì	}	1		<b>]</b>	
79	3-Butyl-1-methylbenzene (m-Butyltoluene)	205	ĺ	1 491	0 859		}				<u> </u>	
80	2,4-Diethyl-1-methylbenzene (2,4-Diethyltoluene)	205		1 5027	0 8748	}	1					
81	<i>n</i> -Pentylbenzene	205 4	<b>-75</b>	1 4878	0 8585				4-mono 101-2, 2,4-di 202			4-Benzamido, 128 9
82	3-Methyl-3-phenylpentane	206	1	1 4958	0 8755	]	1				1	
83		206-6 5	-215	1 4958	0 8645	<b>,</b>	}	2,4,6-iri			1	
	benzene							107 (one form), 114 (another form)		=		
84	1,3-Dimethyl-4-propylbenzene	206 6		1 4998	0 8723			ĺ			1	
	1,2-Diethyl-3-methylbenzene 4-Butyl-1-methylbenzene	206 6 207		1 5105 1 490	0 8910 0 857							
	(4-Butyltoluene)  2,5-Diethyl-1-methylbenzene	207 1		1 5034	0 8758							
	(2,5-Diethyltoluene) 1,2,3,4-Tetrahydronaphthalene	207 6	- 35 79	1 54135				5,7-dı		153 5		Cl <sub>2</sub> + 5,6,7,8-
	(Tetralin)					l	l	95	[			Tetrachloro, 172
	1,3-Diethyl-2-propylbenzene 2,6-Diethyl-1-methylbenzene	207 6 208 8	1	1 5063 1 5106	0 8856 0 8907							
	(2,6-Diethyltoluene)		[			ļ	Į	1				
91	1,2-Dimethyl-4-propylbenzene	208 9	]	1 5000	0 8715		1		1		1	
	1,3-Dimethyl-5-propylbenzene 2-Methyl-3-phenylpentane	209 209	1	1 4933 1 4912	0 8610 0 8678							
	4-tert-Butyl-1,3-dimethyl-	210-4		1 503037	0 937230		Į.	2,5,6-1ri				
	benzene						1	112, al				
95 96	1,4-Di-isopropylbenzene 1,2-Dimethyl-3-propylbenzene	210 4 210 7	-17 1	1 48983 1 5075	0 85676 0 8864							

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n 20 D	D <sup>20</sup>	Picrate	1 3,5 Trimtro- benzene deriva tive	Nitro derivative	Acetamido derivative	Phthalic anhy- dride deriva- tive	2,4-Di- nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
97	1-tert-Butyl-4-ethylbenzene	211		1 4950	0 8635			2,6-dı				
98	d,l-3-Phenylhexane	211 208 3		1 4867	0 8596			94 5, al	2,4-di 207 8			
99	2-Ethyl-1,3,5-trimethyl- benzene	2124	-12 2	1 5074	0 883			4,6-dı	207 8			
100	3-Ethyl-4-isopropyl-1-methyl- benzene	213		1 5006	0 8722			111, al				
101	5-Ethyl-1,2,4-trimethylbenzene	213	–13 ·	1 5075	0 833			3,6 <i>-dı</i> 87 8, al				3,6-Dibromo, 60-1,
102	6-Ethyl-1,2,4-trimethylbenzene	213		1 5118	0 8897			0/0,41				acci
103	2-Phenylhexane	214		1 4882	0 8600				2,4-di 178			
104	2-Methyl-1-phenylpentane	215		1 4847	0 8624				178			
105	4-Isopropyl-1-propylbenzene	215		1 4972	0 8614							
106	1,3-Dipropylbenzene	215 8		1 51551	0 91371							
	5-Ethyl-1,2,3-trimethylbenzene	l		1 5101	0 8863							
108	3-Ethyl-1,2,4-trimethylbenzene	216 6		1 5133	0 895			5,6- <i>dı</i> 79 80, al				
109	1,2,4-Triethylbenzene	2177		1 4982	0 8791							
110	1,3,5-Triethylbenzene	218		1 4965	0 856825			2,4,6- <i>tri</i>		129	Ì	2,4,6-Tribromo, 105
		211 2						1124				
111	2-Methyl-1,2,3,4-tetrahydro- naphthalene (2 Methyl- tetralin)	218		1 5311	0 952			26				
112	1-Methyl-1,2,3,4-tetrahydro- naphthalene (1-Methyl-	219		1 5357	0 9580							
113	tetralin) 4-Ethyl-1,2,3-trimethyl- benzene	220 4		1 5180	0 9019							
114	1,4-Dipropylbenzene	221		1 4914	0 8564							
	3-Methyl-1-phenylpentane	221		1 4876	0 8605				1			
116	2-Propyl-1,3,5-trimethyl-	221		1 5033	0 8782							
117	benzene 1,1-Dimethyl-1,2,3,4-tetra- hydronaphthalene (1,1- Dimethyltetralin)	221		1 5292	0 950			Ar-x, x- di 64 5				
118	3-tert-Butyl-1-isopropyl- benzene	222		1 4832	0 8512							
119		223		1 4911	0 8593							
120	4-tert-Butyl-1-isopropyl- benzene	224		1 4872	0 8665							
	2-Methyl-2-phenylhexane 2,4-Di-isopropyl-1-methyl- benzene (2,4-Di-isopropyl-	225 225		1 4943 1 4990	0 8737 0 8664							
	toluene) 3-Methyl-3-phenylhexane n-Hexylbenzene	226 226 1	-612	1 4980 1 4864	0 8776 0 8575				2,4 <i>-dı</i> 205 6			
		227 228		1 4862 1 5032	0 8607 0 8768							

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point °C	n 20	D <sub>40</sub>	Picrate	1 3 5 Trinitro benzene deriva- tive	Nitro derivative	Acetamido derivative	Phthalic anhy dride deriva tive	2,4 Di nitro phenyl sulfenyl chloride deriva tive	Miscellaneous
127	5-Propyl-1,2,4-trimethyl- benzene	228		1 5095	0 887							
128	6-Methyl-1,2,3,4-tetra- hydronaphthalene (6-	229		1 5357	0 9537					1		
129	Methyltetralin) 2,2-Dimethyl-1,2,3,4-tetra- hydronaphthalene (2 2	230		1 5200	0 935							
	Dimethyltetralin)							ļ				
	2-Phenylheptane	231	1	1 4863	0 8610	}	1				1	
131	5-Methyl-1,2,3,4-tetra-	234 4		1 54395	0 9720	l	ļ				Ì	
	hydronaphthalene (5-		[			ŀ		İ	Í			
	Methyltetralin)					}	1		1		1	
132	2-Ethyl-1,2,3,4-tetrahydro-	235	l	1 523	0 938							
	naphthalene (2-Ethyltetralin)						1		İ			
133	Cyclohexylbenzene	235-6	7 8	1 5329	0 9502	1	1		}		<u> </u>	
134		236	1	1 5321	0 9535							
]	naphthalene (1-Ethyltetralin)										1	
135	2,5-Dimethyl-1,2,3,4-tetra-	236	[	1 526	0 946		1	ļ			ţ	
- 1	hydronaphthalene (2,5-	İ	•								İ	
	Dimethyltetralin)		1				l				1	
136	2,8-Dimethyl-1,2,3,4-tetra-	236		1 526	0 941	1	}		İ		ļ	
- 1	hydronaphthalene (2,8-						ĺ		ł		l	
	Dimethyltetralin)		Ì '				İ	}			Ì	
137	2,7-Dimethyl-1,2,3,4-tetra-	237 8		1 526	0 941		ļ				Į.	
Ì	hydronaphthalene (2,7-								1		l	
	Dimethyltetralin)						1					
138	2,6-Dimethyl-1,2,3,4-tetra-	238	[	1 526	0 941		į .				l	Oxid → trimellitic
	hydronaphthalene (2,6-				1						1	acid 225 35 d
	Dimethyltetralin)					ı			}		1	
	1,4-Di-sec-butylbenzene	239	l	1 4892	0 8590		l .		[		l	
140	1,5-Dimethyl-1,2,3,4-tetra-	239		1 526	0 9410			}				
- 1	hydronaphthalene (1,5		[				1		1			
[	Dimethyltetralin)											
141	3-Ethyl-3-phenylhexane	239		1 4943	0 875		1	}			1	
142	6-Ethyl-1,2,3,4-tetrahydro-	241		1 5331	0 9568							
	naphthalene (6 Ethyl-		İ									
1	tetralin)		1		]		1					
1	2-Methyl-1-phenyl-1-butene	241 2		1 52818	0.000							Nitrosit, 129 30
144	5-Ethyl-1,2,3,4-tetrahydro-	242	i	1 540	0 973							
	naphthalene (5-Ethyltetralin)						1		1			
	n-Heptylbenzene	244		1 4875	0 8595							
146	1-Methylnaphthalene	244 8	- 30 57	1 6174	1 02025		153 5	4-mono		68		Styphnate, 135, al
- 1					1	or -	45,	71,	}			
l						red,	al	4,5-di				
		252				al		143	}			l
147	5,6-Dimethyl-1,2,3,4-tetra-	252		1 552	0 975		}		}			Oxid → melo
- 1	hydronaphthalene (5,6		[		[		į .					phanic acid, 238-
]	Dimethyltetralin)											42
148	6,7-Dimethyl-1,2,3,4-tetra-	252	10	1 5360	0 954		}	5,8 di				
- [	hydronaphtbalene (6,7-							203				
	Dimethyltetralin)						}		]	,		Ì
149	5,7-Dimethyl-1,2,3,4-tetra-	253 1	-6	1 5405	0 9583							Heating with Sat
I	hydronaphthalene (5,7					l						320° → 1,3-Di-
	Dimethyltetralin)				]					<b>'</b>		methylnaphtha- lene, b p 263
						1						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point °C	n 20	D <sub>4</sub> 0	Picrate	1 3 5 Trinitro benzene deriva- tive	Nitro derivative	Acetamido derivative	Phthalic anhy dride deriva- tive	2,4-Di nitro phenyl sulfenyl chloride deriva tive	Miscellaneous
150	5,8-Dimethyl-1,2,3,4-tetra- hydronaphthalene (5,8- Dimethyltetralin)	254		1 547	0 967							Heating with S at 230° → 1,4-Di- methylnaphtha-
151	2-Ethylnaphthalene	257 9	-75	1 59761	0 9922	77 0 7 5,	88 9, 2-					lene, b p 268 Styphnate, 88 90
152	1-Ethylnaphthalene	258 67	- 13 88	1 6062	1 00816	al 98 5	PrOH 111 5 12, al					Styphnate 111 3,
153 154	1,7-Dimethylnaphthalene 1,6-Dimethylnaphthalene	263 263	-13 -14	1 60831 1 6072	1 0115	121 114 5 or, al	137 139 yel					Styphnate, 143 Styphnate, 122
155	1,3-Dimethylnaphthalene	263	-40	1 6078	1 0063	118	135, yel , al					Styphnate, 117 8, w-me al , 2,4,7- Trinitrofluorenone deriv , 142 5, or
156	n-Octylbenzene (1-Phenyloctane)	264 5	-36	1 4845	0 8562			2 4-di 2				
157	1-Allyinaphthalene	265 7		1 6140	1 0228	69	1					
158	1-Isopropylnaphthalene	267 9	- 16	1 5950	0 99565	85 6						Dimer 198 5 9 5 Tetrabromo, 141 2
159	1,4-Dimethylnaphthalene	268, 262-4	7 66	1 6127	1 0166	144, or, me al	165 6 yel, me al					Styphnate, 126-7 or me al
160	1,1-Diphenylethane	268-70		1 5761	1 0033							Oxid → benzo- phenone, 49
	2-Isopropylnaphthalene	a) 268 2 b) 262		1 5772 1 5861	0 9795	93 5, 91 3						
162	2-Propylnaphthalene	273 5, 277 9		1 5872	0 9770	93 4, or al	99					
163	1-Propylnaphthalene	277, 272 5	- 10	1 5952	0 9918	91 2	86 7, al					
164	1,3,7-Trimethylnaphthalene	280	13 5	1 5759	1 007	144, or, al						Styphnate 151 5 or me al
165	1-Isopropyl-7-methyl- naphthalene (Apocadalene)	282		1 5884	0 9833	102, or,						Styphnate, 166 (163-4), yel, al
166	n-Nonylbenzene (1-Phenyl- nonane)	282	-24	1 4838	0 8558	al						4-Sulfonamide, 94 5-5 0 Maleic anhydride → 3-
167	2-Butylnaphthalene	283-5, 292	-81	I 57774	0 9673	71 3, or - yel ,						(4-Nonylbenzoyl) acrylic acid, 82 3
168 169 170	• •	285-90 287 9 289 34	-4 -19 76	1 5768 1 5726 1 5819	0 9687 0 9629 0 97673	al 102 3 96, yel 104 5, or - yel						
						<i>y</i> c 1						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling point, *C	Melting point, °C	n 20	D <sub>4</sub> **	Picrate	1,3,5- Trinitro- benzene deriva- tive	Nitro derivative	Acetamido derivative	Phthalic anhy- dride deriva- tive	2,4-Di- nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
171	<b>4,5-Benzindane</b> (1,2-Cyclopentanonaphthalene)	294 5		1 6290	1 066	110	119 20					2,4,7-Trinitro- fluorenone deriv ,
172	n-Decylbenzene (1-Phenyldecane)	300	-14 38	1 48319	0 85553	•						133
173	1-Pentylnaphthalene	307	-22	1 5725	0 9656		75, yel			}		
	2-Pentylnaphthalene	310	-21	1 5694	0 9561		74, yel			1	•	
175	n-Undecylbenzene (n-Hendecylbenzene, 1-Phenylundecane)	316	~5	1 4828	0 8553	:						4-Sulfonamide, 95 7 6 2
176	1-Hexylnaphthalene	322	-177	1 5647	0 9566		69 74			}	i '	
177	2-Hexylnaphthalene	324	-56	1 620	0 9479	1	67~8, yel					
178	n-Dodecylbenzene (1-Phenyldodecane)	331	3	1 4824	0 8551							4-Sulfonamide, 97 5
179	1-Heptylnaphthalene	340		1 5582	0 9491		<b>j</b> .					
180	2-Heptylnaphthalene	341	1	1 5556	0 9410						i '	•
181	Tridecylbenzene (1-Phenyl- tridecane)	346	10	1 4821	0 8550							
182	1-Octylnaphthalene	356	-20	1 5532	0 9427					1	]	
183	2-Octylnaphthalene	357	2 forms stable -0 5, meta- stable 13	1 5501	0 9356						:	
184	1-Nonylnaphthalene	372	)	1 5477	0 9371		1				]	
185	2-Nonylnaphthalene	372	12	1 5454	0 9298					}	}	
186	1-Decylnaphthalene	387		1 5435	0 9322							·

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri- nitro- benzene derivative	2,4 7-Tri- nitrofluo- renone derivative	Nitro derivative	Phthalic anhy dride deriva- tive	2,4-Di- nitro phenyl sulfenyl chloride deriva- tive	Miscellaneous
1 2	1,2,6-Trimethylnaphthalene Diphenylmethane	14 26 7	146 <sup>10</sup> 264 7, 261 2, 120 <sup>10</sup>	122-3, al	150-1, al			2,4,2',4'- tetra 172			n <sup>20</sup> 1 6010 n <sup>20</sup> 1 5770, D <sup>25</sup> 1 0056, CrO <sub>3</sub> → Benzophenone, 49
3	1,2,3-Trimethylnaphthalene	27 8, al	125-3012	143, or , al	143 5, yel	154 6, al					n∯ 1 5725
4	1,6,7-Trimethylnaphthalene	28, me al	285, 138 <sup>12</sup>	125 6, or, me al	148-9, or, me al	142-3, yel, me al					
5	2-Isopropylazulene	31, bl - vlt				di 113 4					
6	1,4-Dimethyl-7-isopropyl- azulene (δ-Guaiazulene)	31 5, bl - vlt , al	167-812	122 2 5, bl , al	105-6, bl , me al	151-1 5					D <sup>19</sup> 0 9728 (super- cooled) 2,4,6-Tri- nitrotoluene deriv, 89
7	2,6-Dimethylphenanthrene	33-4, me al		135 6, yel, al	148 50, yel, me al						
8	1,2,5-Trimethylnaphthalene	33 5, 31-2, al	147 811	138 40, al	131, al	159-60, al					n <sub>D</sub> <sup>20</sup> 1 6110, D <sub>20</sub> <sup>20</sup> 1 0103, 2,4,6-Tri- nitrotoluene deriv, 90 0 5
9	1-Propylphenanthrene	34 5, me al		100-1, yel, me al							90 03
10	5-Isopropylazulene	34 5				134, 122 3					
11 12	2-Propylphenanthrene 2-Methylnaphthalene	35-6, al 37-8, 34 4	170 <sup>0.2</sup> 240-2, 110-2 <sup>16</sup>	91 2, al 116, al		123, yel	125 6, al	1 <i>-mono</i> 81			$CrO_3 \rightarrow \beta$ -Naphthoic acid, 182
	1-Ethyl-5-methylnaphthalene	40, al	13310	97, or , al							
	9-Isopropylphenanthrene	41-2		109-10							
16	6-Isopropylazulene 2-Ethyl-6-methylnaphthalene	43 44 5	145 5011	109, or	119, yel	124 116-7, yel					2,4,6-Trinitrotoluene deriv, 62, yel
	2-Isopropylphenanthrene	44-5, al		108, yel, me al							
	6-Isopropyl-1-methyl- phenanthrene 2-Ethylazulene	45-6		143, or		107					
	•	45 5, 44-5, bl 46 7, al	204-515	110 1	132-3,	107					
21	1,3,5-Trimethylnaphthalene	47, me	139 510	yel, al 141-2,	or , al 138, yel						
22	3-Ethyl-6-methylphenanthrene	al 47-8		me al 156-6 5,							
23	2-Methylazulene	47-8		or 130-1, bl,al		140-1, dk red,		;			
24	1,3,8-Trimethylnaphthalene	48, me		127 5,	140 5, al	ai					
25	4-Methylphenanthrene	al 49 50, 95% al		or, al 140-1, al	135, or , al						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	Рюгаte	Styphnate	sym Tri- nitro- benzene derivative	2 4 7-Tri nitrofluo- renone derivative	Nitro derivative	Phthalic anhy- dride deriva- tive	2,4-D1- nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
26	1,4-Dimethylphenanthrene	50 1 (cor),		143 5, or -yel	135 5 6 5, or						
27	Bibenzyl (1,2-Diphenylethane)	me al 53	284			102		4,4 -di 180, 2,2',4,4 - tetra 169		132 3	D <sub>50</sub> 0 9782, CrO <sub>3</sub> → Benzoic acid, 121
28	Methylenefluorene (Bi- phenylencethylene)	53		152 3				107			
29		53 4, me		139, or , me al	124 5 or -yel		:				
30	1,3-Dimethylazulene	54		164 6		164 6, al		İ	ļ		
31	7-Methyl-3,4-benzphenanthrene	54045,	1	134 0			178 5		İ		
		al	ļ	4 5, red,			8 8	ļ	ļ		1
32	Pentamethylbenzene	54 3, 51	231 8	131		121		6-mono 154			
33	1,2,4-Trimethylnaphthalene	55-6 50,	14612	148 8 5,	123 5,	165 6 5,		157			
JJ	1,2,4-11methymaphharene	me al		or me	yel, me	me al					
34	3,3'-Dimethylstilbene (sym-D1-m-tolylethylene)	55 6		97							
35	1,4,5,7-Tetramethylnaphthalene	56	162 511	153			152 8 3 4				
	1,2,4,8-Tetramethylnaphthalene	56 7	15010	145 5		167, red, me al					2 4,6-Trinitrotoluene deriv , 88 yel
37	2,9-Dimethylphenanthrene	56 7, al		138, yel , al							
38	1,5-Dimethylphenanthrene	57 8, me al		134 5, or, me							
39	2-Benzylnaphthalene	58	350	93 4, yel, al			124 3 5 4				D" 1176
40	1-Benzylnaphthalene	58 9	350	103-4,							D¹ 1166
41	1,2-Dimethylazulene	58 9, bl,		yel 129 30, blk, al		166 7 br-blk.					
		ا ا		OIK, AI		al			İ		
42	9-Propylphenanthrene	59	265 7022	99, yel , al							
43	1,7-Dimethyl-4-isopropyl- naphthalene	60, al -w			120, yel						
44	3-Methylphenanthrene	62-3	140 50°	137~8,							
45	3,4-Dimethylphenanthrene	62 3, me al		yel , al 129-30, or -red,	142 3, or -red,	:					
46	1-Ethylphenanthrene	62 5, al		al 108-9,	al 144, yel,						
				or, al	al						
	sym-Diphenylacetylene (Tolane) 9-Ethylphenanthrene	62 5, al 62 5 3 0, 66, bz -	198 200	111, yel 123-4, or -red,		96, yel			ĺ		D <sup>78</sup> 1 0603 n <sup>78</sup> 1 6582
		pet eth		al							- 32

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, *C	Picrate	Styphnate	sym-Tri- nitro benzene derivative	2 4,7 Tri nitrofluo renone derivative	Nitro derivative	Phthalic anhy- dride deriva- tive	2,4 Di nitro phenyl sulfenyl chloride deriva tive	Miscellaneous
49	1,4,5-Trimethylnaphthalene	63	14512	144 5,	129 30						
50		63, al		red, al		}					In H₂SO₄ sol → grn
51	1,4,6,7-Tetramethylnaphthalene	63 4, al		148 9			172 4 3 4				
52	1,2,3-Trimethylphenanthrene	63 8 4 8		187 8, or		200 7 1 5, yel , bz -al					
	1,8-Dimethylnaphthalene	65 63	1401×	156 148	160					į	
54	8-Methyl-3,4-benzphenanthrene	65 6, al		107 8, red, al							
55	2-Ethylphenanthrene	67 8, me al 64 5		95 5 6 0, yel, al, 92 3			180 7 0 9				
56	3,4-Benzphenanthrene	68, al	i	120 8- 8 5, red, al			170 8				
57	1,3,7-Trimethylphenanthrene	68 9 me			160 1						
58	4-Isopropyl-1-methyl- phenanthrene	68 8 5		113 6 4							
59	4,8-Dimethylazulene	me al 69 70,		or , al 157-8,	:	179 80					
		bl, al		blk al		red-br , al					
60	Biphenyl	69 2 71	254 5 145 <sup>22</sup>			<b>a</b> 1		4 4'-di 237 229, 2,2',4,4'- tetra	225	142 3	n <sub>4</sub> <sup>20</sup> 1 475 D <sub>4</sub> <sup>20</sup> 0 866
61	2-Methyl-3,4-benzphenanthrene	70 4-1 0 al		141 8 3 2, red,		145 bz pet eth	158 8 5, or red,	150			
62	3-Methylpyrene	71 2, al		bz -al 211-2, br -red, bz			aq al				Conc H <sub>2</sub> SO <sub>4</sub> sol → yel with grn fluorescence on heating → olive grn with vlt fluores-
63	1,4,7-Trimethylphenanthrene	72 3		141 2,	129 30						cence
64	1,4-Dimethylanthracene	74, al		me al 140							
66	4,9-Dimethyl-1,2-benz- anthracene	75 me al		116, br , me al		124-5, red, me					
67	Benzalfluorene (ω-Phenyldibenzfulvene)	76, al		115 6		al					Dibromide, 116 d
68	1,3-Dimethylphenanthrene	76 7, ac		153 5,	165 6						
69	1-Methyl-3,4-benzphenanthrene	a 77 8	210° 4	or , al 112-3,			171 8	Ì			
	3-1sopropyl-1-methyl- phenanthrene	79	18015	red, al 150	155		2 2	ļ		į	

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym Tri- nitro- benzene derivative	2,4,7-Tri- nitrofluo- renone derivative	Nitro derivative	Phthalic anhy- dride deriva- tive	2,4-Di- nitro phenyl sulfenyl chloride deriva- tive	Miscellaneous
71	1,2'-Binaphthyl	79 80, 76		127 0-7 5 (cor ),			145 0 6 9				
72	2,3-Dimethylphenanthrene	79 80		or 146 7, or -red, al	147 8, or , al						
73	1,2,4,5-Tetramethylbenzene (Durene)	79 2, 80	196 8					3,6- <i>d1</i> 205	263		
74	1-Ethyl-2-methylphenanthrene	80, me al		134 5, me al		152 5-3 0					
75	1,5-Dimethylnaphthalene	80 0 0 5, 85% al		140							
76	6-Methyl-3,4-benzphenanthrene	80-1, al	206-8²	118 0–8 5, red, me al			144 2- 4 5				ı
77	Naphthalene	80 3	218	149		153	153 4	1-mono 61,57	172	173 4	
78 79	1,3,6,8-Tetramethylnaphthalene 1-Ethyl-7-methylphenanthrene (Homopimanthrene)	81 81, al	115-6²	151-2 115-6, yel, me		175-6					Quinoxaline deriv , 154, ac a
80	9-Methylanthracene	81 5	196-712	137 d , red-br							D <sub>1</sub> <sup>qq</sup> 1 065, n <sup>p</sup> 1 6959, Irradiation in acetone → dimer, 228 0-8 5 Photo- oxide, ca 80, exp
	1-Isopropyl-7-methyl- phenanthrene	82 3	170'	119 20, or	148 9, yel	163 4, yel				,	
82	•	83, bl - vlt		137, 125		141			i		
83 84	1,3-Dimethylanthracene 2,2'-Dimethylstilbene (svm-Di-o-tolylethylene)	83 83	176 8010	136 102							bl fluorescence
85	1-Methylanthracene	85 6, me al	199 200	115 6 6 2, red, me al	176 4 7 0, red, me al		219 0- 9 8, red, bz				D <sup>99</sup> 1 0471 n <sup>99</sup> 1 6802, Irrad- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
86	1,7-Dimethylphenanthrene	86		132, me	159, me al		,				
87 88	1,6-Diphenylnaphthalene 1,6-Dimethylphenanthrene	86 7 87-8, me al		106-8 134, yel, al							
89	1,9-Dimethylphenanthrene	88, al		163 5, or -yel ,	181				ļ		
90	9-Methylphenanthrene	90 1, aq		me al 152 3, al							
91	1,2,10-Trimethylanthracene	al 90614, yel		138 5 9 5, al		169 6- 170 2, al					
92	7-Ethyl-1-methylphenanthrene	91 0 1 5, 84 5			141-2	135-6		İ			
93	Triphenylmethane		358					4,4',4''- tri 206			Br₂ → bromo deriv , 152
95	5-Isopropylnaphthanthracene	92, ac, a		157							

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point *C	Picrate	Styphnate	sym Tri nitro benzene derivative	2,4 7-Tri- nitrofluo- renone derivative	Nitro derivative	Phthalic anhy dride deriva tive	2 4 Di nitro phenyl sulfenyl chloride deriva tive	Miscellaneous
96	3,9-Dimethyl-1,2-benz-	93		137-8,		145, red,					
97	anthracene 5,6-Benzindane (2 3-Cyclopentenonaphthalene)	94		red, al 120-1		bz -lgr					
98	12-Isopropylnaphthanthracene	94 5 ac		157 8							
99	Acenaphthene	96 2, yel al	278	162, or - red, al		168, yel , al	175 6	5-mono 101	198	187 9 d	n <sub>D</sub> <sup>99</sup> 1 6066, D <sub>4</sub> <sup>99</sup> 1 0242 1,2-D <sub>1</sub> bromide, 121 3
100	2,7-Dimethylnaphthalene	96 7, al	262	136 0- 6 5, yel, me al	158 0- 9 5, yel, me al		<u>.</u>				oronnas, 121 s
101	7-Isopropyl-1-methylfluorene	96 5 7 0,		u				dı ca 245			
102	Azulene	al 98 5 99	270 d , 115 3510	120 d		167		243			Heat at 270° → Naphthalene, 80 3 2,4,6-Trinitrotoluene deriv, 95 5-100
103	Retene (7-Isopropyl-1-methyl- phenanthrene)	100 5 101, al	390, 158 6 5° 2	124-5	141 2	139					D 1 035
104	Phenanthrene	101, al , 96 3	340, 332	144 132 8		158 145	197			250 1	n <sub>D</sub> 1 5973 D 1 182
105	2,7-Dimethylphenanthrene	101 2, me al		152 3, or, al							1 102
106	2,3,6-Trimethylnaphthalene	102, 92 3	286, 146-8 <sup>14</sup>	130, yel,	165, yel, me al						
107	2-Phenylnaphthalene	102-3	140-8	me al	ine ai		169 5 70 5				
108 109	1,2,3,4-Tetrahydroanthracene 2,3-Dimethylnaphthalene (Guaiene)	103-5 104 0 4 5 (subl ),	265-6	123 4			182 4				D <sub>4</sub> <sup>20</sup> 1 008
110	Ethylidenefluorene	104, ac		155 6							Dibromide, 93 5
111	1,7-Dimethylfluorene (Gibberene)	a 107 0 7 5		85–6, or - red		98, yel , al					In H₂SO₄ sol → bl
112	1,1'-Dinaphthylmethane	110, al	> 360, 270 <sup>14</sup>	142		141 5	216				
113	Fluoranthrene	110	201.2	185 6			216				
114	2,6-Dimethylnaphthalene 2,4-Dimethylphenanthrene	111 111, al	261–2	143 138~9, 142, me			156			ļ	
116	Fluorene	113 5, 116–7	293-5	87, 77		105	179	2-mono 156, 2,7-di 199	228		CrO <sub>3</sub> → Fluorenone, 84
117	4,10-Dimethyl-1,2-benzan- thracene	114, pa yel, me al		162, blk				177			
118	4H-Cyclopenta(def)phenan- threne (Phenanthrindene)	116, al	353	166							Benzylidene deriv , 108
119 120	1,3,8-Trimethylphenanthrene 11-Methylnaphthanthracene	116 117-8		174-5 159-60, dk red		188 170, or	199 238 2 8 6			:	100

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri nitro- benzene derivative	2,4 7-Tri nitrofluo renone derivative	Nitro derivative	Phthalic anhy- dride deriva tive	2,4-Di- nitro- phenyl sulfenyl chloride deriva tive	Miscellaneous
121	5-Methylchrysene	117 2 7 8, bz -		142 6 3 0, or -		172 6 3 6, bz -					
122	1,2,5,6-Tetramethylnaphthalene	al 118	150 6010	red, al 156-7 red	166, bz	al 180 0 0 5, bz					
123	Cyclohept(fg)acenaphthene (Acepleiadene)	118 20 (subl), red, al		150 d		0 3, 62					Maleic anh add comp , 248-50, bz
1	1,2,7-Trimethylphenanthrene 1',10-Dimethyl-1,2-dibenzan- thracene	120 1, al 122 3, al		148 9 147 8, red, al	169 70						In H₂SO₄ sol → red
126	9,10-Dimethyl-1,2-benzan- thracene	122 3		112 3, blk , al di 102 6, red, al		i i			; ;		Highly carcinogenic
127	Benz(bc)aceanthrylene	122-3, al		141 5 2 0, dk red , al		162 5 3 0 or, al					
128	••	123, aq al		139, yel, al	152 3, yel						
129	1,6,7-Trimethylphenanthrene	123 4 al		165 6, or	111 2						
130	1,1'-Diacenaphthene	(a) 124, al, (b) 169, pet eth		<i>di</i> 270, red							
- I	trans-Stilbene 3,4-Benzfluorene	124, al 124 5, al	305720	94 5 130 1, red, al		115 20	191 8				
		125, al 126 2 7 2, al		152 149 50, red-br, al			221 4 1 8 163-4, al				
}	5,8-Dimethyl-1,2-benzan- thracene	131, bz - al		175, red, al							
	8-Isopropylnaphthanthracene 1,4,5,8-Tetramethylnaphthalene	132 3 132 3		118	143 4 4 2		158-9				!
	12-Methylnaphthanthracene	138, yel		115 6, red	143 4 4 2	:	234 5 5 0, 209 5 9 7, red, al				
139	2-Methyl-1',2'-benzpyrene	pa yel, me al, after fusing, 1400		184 5, br,bz- lgr		211 5- 20, red, bz -lgr	100, 41				
140	1,5-Dimethylanthracene	139 40, pa yel		166 7, scar, al							
141	7-Methylnaphthanthracene	140		174, dk red			236 l- 6 5				

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS b) Solids. (Listed in order of increasing m.p.)\* (Continued)

						,					· · · · · · · · · · · · · · · · · · ·
No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri- nitro- benzene derivative	2,4,7-Tri nitrofluo- renone derivative	Nitro derivative	Phthalic anhy- dride deriva- tive	2,4-Di- nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
142	3,6-Dimethylphenanthrene	141, al		172 3,							
				or -yel, me al							
143	5-Methyl-3,4-benzphenanthrene	141 4 1 9		me ai	-		130 6 1 4, red				
144	1,4-Dimethylchrysene	142		141, red,							
145	1,2-Dimethylphenanthrene	142 3, al		аl 148, ог, al	153, yel ,						
146	8,10-Dimethyl-1,2-benzan- thracene	146, bz - al	•	166, red, al							
147	1,2,8-Trimethylphenanthrene		210 20 <sup>15</sup>	164 5,		193 0 3 5 al					
148	3-Methyl-1',2'-benzpyrene	146 7 8 I, yel , al -eth		or , al 179 5 80 0, br -red,		210 5 11 0, bz -lgr					
149	9-Methyl-1',2'-benzpyrene	146 8 8 0, yel,		bz -lgr		218 5 9 5, red,					
150	9-Phenylfluorene	hexane 147 8, al				bz -lgr		di ca			Bromide, <i>di</i> 181 2,
	:		-					240 tetra ca 235			tri 167 71
151	2-Methylnaphthanthracene	149 50, al		180			218 7 9 2	d			
152	Pyrene	149 50, pa yel	335	222, red, al 220, 227			242 3				
153	9-Methylnaphthanthracene	150 5 1 5, al		157 8			225 1 5 4		j		
154	4-Methylchrysene	151 0 1 5, bz- al		two forms 135 0 5 5, red, bz -lgr, 137 5 8 0, or,							
155	trans-trans-1,4-Diphenyl- 1,3-butadiene (trans-trans-	152 5	350	bz -lgr 152 3							Maleic anh add comp , 198-200
156	Distyryl) Cinnamalfluorene	155, pa yel ,		di 178 9							Tetrabromide, ca 160 d
157	5-Methylnaphthanthracene	ac a 155 9 6 9, bz -		153			235 4 5 6				
158	1,2-Benzanthracene	pet eth 159-60		133			160				
	8-Methylnaphthanthracene	160 0-0 6		166			243 2				
160	1,1'-Binaphthyl	160 5	240 412	145		]	3 6				
	Di-1-naphthastilbene (sym - Di-1-naphthylethylene)	161, pa yel, al		tri 210							

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

No :	Name	Melting point, °C	Boiling point, *C	Picrate	Styphnate	sym Tri- nitro- benzene derivative	2 4 7-Tri nitrofluo- renone derivative	Nitro derivative	Phthalic anhy dride deriva tive	2 4 Di nitro- phenyl sulfenyl chloride deriva tive	Miscellaneous
162	6-Methylchrysene	161 0		170 0		189 8					
		1 4, et		0 6, or ,		190 6,		]			
		ac -al		bz -ai	ĺ	yel,			;		
163	3-Methylnaphthanthracene	163 0 3 9, al		1460 68		bz -al	239 0 9 6				
164	2,6-Dimethyl-1,2-benzan-	164, ac		199 200							
	thracene ,	a						]			]
165	Cyclopentadienophenanthrene	164 5		146 7		172 3					In H <sub>2</sub> SO <sub>4</sub> sol → bl
	10,11-Benzfluoranthene	165, 166,	264	194 5		220 0 0 5 174					
167 168	Hexamethylbenzene	165 170 0	264	164 0	1	11/4	1				
.00	3-Methylchrysene	0 5, bz -		4 5, grn ,							
		pet-eth		al			1			,	
169	Cholanthrene	170-1.		167 8,		Ì	245 6	1	1	,	
		173	j	vit -blk ,							
		(subl ),		bz							
		pa yel,						1			
170	6 Mathel 1/ 2/ hangayana	bz -al 171 0		181 5	209 10,						
170	6-Methyl-1',2'-benzpyrene	1 5, yel,		2.5 br	red bz			ļ			
		bz -lgr	1	bz -igr	lgr		i				
171	6,7-Dimethyl-1,2-benzan-	174, et	]	170	-6.						
	thracene	ac									
172	1,2-Benzpyrene	176 5 7 5, pa yel, bz -	310 210	197 8, vlt -blk							
		me al									
173	5,10-Dimethyl-1,2-benzan-	177, bz -		174, red-							
174	thracene	al		blk , bz							
/4	4,5-Benzpyrene	178-9, bz		229 30, red, bz							
75	9,10-Dimethylanthracene	180 1, al		176-7 d						ľ	
	10-Methylnaphthanthracene	183 0-	İ	1590 94							2 4,6 Trinitrotoluer
	•	3 6, yel,					[				deriv, 224 8 5 0
		al		1			1 1				
177	5,6-Dimethyl-1,2-benzan-	187 8, al	}	191 3,				7			
70	thracene	100 101	4.53	red, al			l.,,				te lit a
1/8	2,2'-Binaphthyl	188, 181	452	184			171				Lt bl fluorescence, KMnO <sub>4</sub> → Phthali acid, 206 8
79	1,2-Benzfluorene (Chryso-	189-90,	413, 398	di 127 5,		144-5	213 5 5 5	;			, == 3 0
	fluorene)	ac a, 183-4	400	124 6							
80	1,8-Dimethylphenanthrene	191-2, bz		151 2,			193 4			- 1	
.				yel						l	
181	8-Methyl-1',2'-benzpyrene	192-3,		205, dk		233 d ,					
إريا	Diffuoronulidone (D.L.	yel, bz 194-5		br, bz 177-8		red, bz		two dı-			Dibromide, 312, red
82	Bifluorenylidene (Dibi- phenyleneethylene)	(cor),		'''				two ai-		ļ	bibromide, 312, red
	phonyleneemylenej	red						171, dk			UL
								red, 170,			
ļ								or red			
83	1,2,7,8-Dibenzanthracene	196, bz		212, brt							Bl -grn fluorescence
		1	l	red							ın sol

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri- nitro- benzene derivative	2,4,7-Tri- nitrofluo- renone derivative	Nitro derivative	Phthalic anhy dride deriva tive	2,4-Di nitro- phenyl sulfenyl chloride deriva- tive	Miscellaneous
184	4-Methylnaphthanthracene	197 4-		139 40,		-	228 2-				
185	1,2,3,4-Dibenzanthracene	8 0, al 200 2, pa yel, ac a		It red 207, red			8 8				In conc H₂SO₄ sol → pa vlt -red
186	Di-2-fluoreny lmethane	201 2, al		:				dı 256 7			$Na_2Cr_2O_7 \rightarrow Di-2$ - fluorenyl ketone, 297-8, yel, ac a
187	2,3-Benzfluorene	208 9				ļ ļ	221 2- 2 0				277 5, 761, 40 4
188	5-Methyl-1',2'-benzpyrene	215 7- 6 2, yel, eth-al		207 8, vlt - blk ,		230 1, red, bz - lgr					
189	Anthracene	216 2	340 (cor ), 226 5 <sup>53</sup>	bz -lgr 138	:	164	194				D <sub>4</sub> <sup>27</sup> 1 25, D <sub>1</sub> - bromide, 122, CrO <sub>3</sub> → Anthra- quinone, 273
190 191	11,12-Benzfluoranthene 4-Methyl-1',2'-benzpyrene	217 217 5 8 0, yel	480	170 1 203 4, vlt -br , bz		182	236 7				quinone, 273
192	2,8-Dimethylchrysene	218, bz		171 2, bz	204, or , bz	195, yel , bz					
193	2-Methylchrysene	224 5 5 5, bz - al		143 6, yel, al							
194	6,12-Dimethylchrysene	237			207 d , bz	222					
195	1,2-Benzphenanthrene (Chrysene)	254, bz	448	273		186	248 9		214		Dibromide, 275
196 197	Di-2-naphthastilbene (sym- Di-2-naphthylethylene)	254 5, bz 254 5		215		174-6,					
	- Artificial yacate	(cor ), (vac- uum), bz				yel , bz					
198	2,3,6,7-Dibenzphenanthrene	257, grn - yel		184, or - red							Bl fluorescence in sol, intense yel- grn in u v
199	2,3,5,6-Dibenzphenanthrene	261, grn - yel, ac a		di 213, or -red							BI fluorescence in bz sol, grn fluo- rescence in u v
200	1,2,5,6-Dibenzanthracene	262, met, ac		<i>dı</i> 214, or				:			rescence in a v
	Perylene Picene (1,2,7,8-Dibenz- phenanthrene)	273 4 365 6, xyl	518 20				270-1 257 8				Dibromide, 295, 2,7- Dianthraquinone add comp, 299- 300
203	1,2,3,4,5,6,7,8-Tetrabenz- anthracene	428 9					318-9, red				500
204	Coronene (Hexabenzobenzene)	438-40 (cor), yel, bz	525	>250 d , red, bz		>280 d , or , bz	100		:		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE V**

S-Alkylthiuronium picrate (S-Alkylisothiourea picrate)\*

$$RX + S = C \xrightarrow{NH_2} \rightarrow \begin{bmatrix} RS - C & NH_2 \\ NH_2 \end{bmatrix}^{\dagger} X^{-}$$

$$S - Alkylthiuronium salt$$

$$\begin{bmatrix} RS - C & NH_2 \\ NH_2 \end{bmatrix}^{\dagger} X^{-} + O_2 N - OH \rightarrow \begin{bmatrix} RS - C & NH_2 \\ NH_2 \end{bmatrix}^{\oplus} \begin{bmatrix} O_2 N - OH & OH \\ NH_2 \end{bmatrix}^{\ominus} + HX$$

$$S - Alkylthiuronium picrate$$

From the alkyl halide with thiourea in 95% ethanol, followed by addition of picric acid in ethanol For directions and examples see Linstead, pp 82 3, Shriner, p 245, Vogel, pp 291 2, Wild, p 43, E L Brown and N Campbell, J Chem Soc, 1699 (1937), W J Levy and N Campbell, J Chem Soc, 1442 (1939)

From the alkyl halide with thiourea in ethylene glycol, followed by addition of picric acid in ethanol See Cheronis, p 550, H M Crosby and J B Entrikin, J Chem Ed, 41, 360 (1964)

1-Naphthylamide ( $\alpha$ -Naphthalide) \*

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with 1-naphthyl-isocyanate in ether

For directions and examples see Cheronis, pp. 551, 553 Linstead, p. 83 Shriner, p. 244, Vogel, pp. 290-1, Wild, pp. 35-37 H. Gilman and M. Furry, J. Amer. Chem. Soc., 50, 1214 (1928), H. W. Underwood and J. C. Gale, J. Amer. Chem. Soc., 56, 2117 (1934)

Anılıde \*

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with phenylisocyanate in ether

For directions and examples see Cheronis, pp 551, 554, Linstead, p 83, Shriner, p 244, Vogel, pp 290 1, Wild, pp 35-7, A M Schwartz and J R Johnson, J Amer Chem Soc, 53, 1063 (1931), H W Underwood and J C Gale, J Amer Chem Soc, 56, 2117 (1934)

Alkylmercuric halide \*

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with the mercuric salt of the same halogen in ether

For directions and examples see Cheronis, pp 551, 554, Shriner, p 244, Vogel, p 291, Wild, p 38, C S Marvel, C Gauerke and E L Hill, J Amer Chem Soc, 47, 3009 (1925), E L Hill, J Amer Chem Soc, 50, 167 (1928), K H Slotta and K R Jacobi, J prakt Chem, 120, 249 (1929)

#### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

Picrate of alkyl 2-naphthyl ether (Molecular complex).\*

Picrate of alkyl 2-naphthyl ether (Molecular complex)

The alkyl 2-naphthyl ether is obtained from the alkyl halide with 2-naphthol in ethanolic sodium or potassium hydroxide.

For directions and examples see: Cheronis, p. 551; Linstead, p. 83; Shriner, p. 244; Vogel, p. 292; Wild, p. 44.

The picrate is obtained from the alkyl 2-naphthyl ether and picric acid in chloroform or ethanol.

See: Cheronis, p. 551; Linstead, p. 83; Vogel, p. 292; Wild, p. 44; O. L. Baril and G. A. Megrdichian, J. Amer. Chem. Soc., 58, 1415 (1936); V. H. Dermer and O. C. Dermer, J. Org. Chem., 3, 289 (1938).

Alkyl 2,4-dinitrophenyl thioether (Alkyl 2,4-dinitrophenyl sulfide).

$$RI + O_{2}N \longrightarrow SH \longrightarrow O_{2}N \longrightarrow SR + KI + H_{2}O$$

$$RCI + O_{2}N \longrightarrow SH \longrightarrow O_{2}N \longrightarrow SR + KCI + H_{2}O$$

$$Alkyl 2,4-dinitrophenyl thioether$$

From the alkyl bromide or iodide with 2,4-dinitrothiophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous potassium hydroxide.

For directions and examples see: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, J. Amer. Chem. Soc., 73, 1968 (1951).

From the alkyl chloride with 2,4-dinitrothiophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) with potassium iodide and aqueous potassium hydroxide.

See: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, J. Amer. Chem. Soc., 73, 1968 (1951).

Alkyl 2,4-dinitrophenyl sulfone.

$$O_2N$$
 $SR$ 
 $KMnO_4$ 
 $O_2N$ 
 $SO_2R$ 

Alkyl 2,4-dinitrophenyl sulfone

From the alkyl 2,4-dinitrophenyl thioether (prepared from the alkyl halide as above) in glacial acetic acid, with aqueous potassium permanganate.

For directions and examples see: R. W. Bost, J. O. Turner and R. D. Norton, J. Amer. Chem. Soc., 54, 1985 (1932).

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

#### EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

6-Nitro-2-mercaptobenzothiazole derivative.

From the alkyl halide (especially a dihalide) and 6-nitro-2-mercaptobenzothiazole in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous sodium hydroxide.

For directions and examples see: Cheronis, p. 557; H. B. Cutter and H. R. Golden, J. Amer. Chem. Soc., 69, 831 (1947); H. B. Cutter and A. Kreuchunas, Anal. Chem., 25, 198 (1953).

Substituted N-alkylphthalimides.

From the alkyl halide with the potassium salt of the substituted phthalimide.

For directions and examples see: Wild, p. 41.

From the alkyl halide with the potassium salt of the substituted phthalimide or with the substituted phthalimide and potassium carbonate in dimethylformamide.

See: J. H. Billman and R. V. Cash, J. Amer. Chem. Soc., 75, 2499 (1953).

From the alkyl halide with the substituted phthalimide and potassium hydroxide in methanol-dioxane mix-

See: C. H. Allen and R. V. V. Nicholls, J. Amer. Chem. Soc., 56, 1409 (1934).

Nitro derivative.\*

From the aromatic halide with fuming and concentrated nitric acids.

For directions and examples see: Wild, p. 450.

From the aromatic halide with 100% nitric acid.

See: Cheronis, pp. 559-561, 563.

From the aromatic halide with nitric and sulfuric acids.

See: Cheronis, pp. 560, 563; Vogel, p. 543.

Sulfonamide.\*

$$\begin{array}{c} \text{ArX} & \xrightarrow{\text{CISO}_3\text{H}} & \text{Ar(X)SO}_2\text{CI} \\ & \text{Sulfonyl} \\ & \text{chloride} \end{array}$$

$$\text{Ar(X)SO}_2\text{CI} & \xrightarrow{\text{NH}_3} & \text{Ar(X)SO}_2\text{NH}_2 \\ & \text{Sulfonamide} \end{array}$$

The sulfonyl chloride is prepared from the aromatic halide and chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with concentrated ammonia or dry ammonium carbonate.

For directions and examples see: Cheronis, pp. 564, 638, 639; E. H. Huntress and F. H. Carten, J. Amer. Chem. Soc., 62, 511 (1940).

NOTE: For additional information regarding directions and examples for the derivatization of aromatic halides (through the above reactions or additional ones, e.g., side-chain oxidation) see explanations and references to Table IV, pp. 32, 33, 34.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

### A) Alkyl and cycloalkyl halides 1. Chlorides

a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	n²º	D₹º	S-Alkyl thiuronium picrate	i Naph- thyl amide	Anılıde	Alkyl mer- curic halide	Picrate of 2-naph- thyl ether	2,4-Di- nitro- phenyl thio- ether	2,4-Dı- nıtro- phenyl sulfone	Miscellaneous
1	Methyl chloride	-24	<u> </u>		224	160	114	167		128	185,	Methyl-2-naphthyl ether,
2	Vinyl chloride	-14			104						189	70 Polymerizes to solid on irradiation
3	Ethyl chloride	13		0 9178	188	126	104	192	104	115	156, 160	magiation
<b>4</b> 5	Isopropyl chloride 1-Chloropropene	36 5 37	1 378	0 859	196,148		103 114		95		100	
6	Allyl chloride	44 5	1 416	0 940	155		114		99			3-Nitrophthalimide deriv , 100-1
7	n-Propyl chloride	46 5	1 388	0 889	181, 176	121	92	147	81	84	126	uciiv , 100-1
8	tert-Butyl chloride	51	1 386	0 846	160-1	147	128	122-3				
9	Chloroprene	59	1 458	0 9583								Heating with maleic anh and boiling the adduct in water → 4-chloro-1,2,3,6-tetrahydro-phthalic acid, 173-5
	sec-Butyl chloride	68	1 397	0 874	190, 166	129	108	30 5	86	66	120	
11 12	Isobutyl chloride Methallyl chloride (3- Chloro-2-methyl-1- propene)	69 72	1 398 1 4340	0 881	174	125	109	•	85	76	105	Phthalimide deriv , 89-90
13	1	78	1 402	0 886	180, 177	112	63	128	67	66	92	
14	Neopentyl chloride	85		0 879		<u> </u>	130-1	117-8				
	tert-Amyl chloride	86	1 405	0 865		138	92					
	3-Chloro-1-pentene	93-4	1 4254	0 8978			l		1			Phthalimide deriv, 78 9
17	DL-3-Chloro-2-methyl-1- butene	94	1 4304	0 9088								Br <sub>2</sub> → dibromo deriv, 197-8
18	1	94	1 4320	0 925 (0 905)								Br₂ in ether → dibromo deriv, 197
19	l '	97	1 4079	0 8695		102 3	94 6				ļ	
20		97	1 4082	0 8723		117-8	127,					
21	Isoamyl chloride	100	1 409	0 872	179, 173	111	108	86	94	80	124	
22	chloride)		1 412	0 882	154	112	96	110	67	80	83	į
	1-Chloro-2-pentene	109-10	1 43521	0 90841 5								Phthalimide deriv, 69-70
24 25	2-Chloro-2-methylpentane 3-Chloro-2,2-dimethyl- butane (Pinacolyl chloride)	110 3	1 4126 1 4181	0 863 0 8767		116-8	71-4	89-90		:		
26	·	114-5	1 4510	1 005				108	1			
27	4-Chloro-2,2-dimethyl- butane	115	1 4160	0 8670			138-9	133				
	3-Chloro-3-methylpentane		1 421	0 89			87–8					
	2-Chloro-2,3-dimethyl- butane  3-Hexyl chloride (3-	117-9	1 4163	0 876922				1				Carbonation of Grignard and conversion of acid to amide, 125-7, Br <sub>2</sub> → 2,3-dibromo deriv , 166-8 (173-4) Grignard reagent +O <sub>2</sub> →
	Chlorohexane)											3-hexanol 2,4-Di- nitrophenylhydrazone, 147 8 Semicarbazone, 110 11

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

### A) Alkyl and cycloalkyl halides 1. Chlorides

a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	n 20 D	D <sub>20</sub>	S Alkyl thiuronium picrate	i Naph thyi amide	Anılıde	Alkyl mer curic halide	Picrate of 2 naph thyl ether	2 4 Di nitro- phenyl thio ether	2 4 Di nitro phenyl sulfone	Miscellaneous
31	2-Hexyl chloride (2-	123 4	1 414221	0 869421			91-2					
32	Chlorohexane) 1-Chloro-2-ethylbutane	125-7	1 4230	0 8914			81 2					
33	3-Chloro-2,2,3-trimethyl- butane	133					83-4					Carbonation of Grig- nard → acid, 80
34 35	n-Hexyl chloride Cyclohexyl chloride	133 143	1 420 1 462	0 878 0 989	157	106 188	69 146	125		74	97	6-Nitro-2-mercapto-
						100						benzothiazole deriv 100-1 2 sulfone, 189
36	5-Chloro-2,3-dimethyl- pentane	152	1 4299	0 8825			80 1					
37	n-Heptyl chloride	159	1 426	0 877	142	95	57	120		82	101	
38	Benzyl chloride	179	1 539	1 100	188	166	117	104	123	130	178, 182	Quaternary salt with di- methyl aniline, 110
	n-Octyl chloride	180, 184	1 431	0 875	134	91	57	115		78	98	
40 41	$\beta$ -Phenylethyl chloride  4-Methylbenzyl chloride	190 192	1 5380	1 0512			97		84			Phthalimide, 120 117
	•				!							Carbonation of Grig- nard → 4-tolylacetic acid, 92
42	α-Phenylethyl chloride	195	1 523725	1.06420			133					Dhahalamada dagaa 117.0
43	3-Methylbenzyl chloride	195–6	1 532725	1 00420								Phthalimide deriv, 117-8, Carbonation of Grig- nard → 3-tolylacetic acid, 61
44	2-Methylbenzyl chloride	197 9										Phthalimide deriv, 148-9, Heating with pyridine -> alkyl pyridinium chk ride 183
45	β-Chlorostyrene	197-9	1 57125	1 109			,					Br <sub>2</sub> in chl → dibromo deriv, 32, Oxid → ben- zoic acid, 122
46	n-Nonyl chloride	202	1 434	0 870	131			ļ		86	92	
47	2-Chlorobenzyl chloride	213–4										5-Nitro deriv 66 Carbonation of Grignard → 2-chlorophenylacetic
48	4-Chlorobenzyl chloride	214, 222					166					acid, 94-5 Oxid → 4-chlorobenzoic
49	3-Chlorobenzyl chłoride	216		1 269545								acid, 242 Oxid → 3-chlorobenzoic acid, 158, 155, Heating
												with 2,4-dichlorophenol in toluene -> 2-(3-
Ī						,						chlorobenzyl)-4,6-dı-
50	n-Decyl chloride	223	1 437	0 868	137							chlorophenol, 59-60
	4-Isopropylbenzyl chloride				-						•	Carbonation of Grig- nard → acid, 52
52	n-Undecyl chloride (n- Hendecyl chloride)	241	1 440	0 868	139							40.0, 32
53	n-Dodecyl chloride (Lauryl chloride)	243–4	1 4425	0 8673	1			114				Refluxed with pyridine> alkyl pyridinium chlo- ride, 92
54	Cetyl chloride (Hexadecyl chloride)	286 d			155			102			!	3-Nitrophthalimide deriv , 101, Alkyl sac- charin deriv , 98

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

A) Alkyl and cycloalkyl halides 1. Chlorides b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, *C	Boiling point, *C	S-Alkyl thiuro- nium picrate	I-Naph- thyl amide	Anilide	Alkyl mer- curic halide	Picrate of 2-naph- thyl- ether	2,4-Di- nitro- phenyl thio- ether	2,4-Di- nitro- phenyl sulfone	Miscellaneous
1	1,3-Bis(chloromethyl)benzene (m-Xylylene dichloride)	32-4	250-5							-	Diphthalimide deriv, 237
2	4-Bromobenzyl chloride	36-8, 50	236	219							Oxid → 4-bromobenzoic acid, 251
3	2,4,6-Trimethylbenzyl chloride	37	13022				-				Hydrolysis → 2,4,6-trimethyl- benzyl alcohol, 88-9, Phthali- mide deriv, 209-10
4	2,6-Dichlorobenzyl chloride	39–40									Carbonation of Grignard → 2,6- dichlorophenylacetic acid, 157 8
5	1-Chloro-2,2,3,3-tetramethyl- butane	52-3					170-1				Grignard treated with O₂ at  -5 → carbinol, 149-50
6	1,2-Bis(chloromethyl)benzene (o-Xylylene dichloride)	54-5	239–41				<u> </u>				Oxid → phthalic acid, 200-6
7	4-Nitrobenzyl chloride	71					ŀ				Oxid → 4-nitrobenzoic acid, 241
8	1,4-Bis(chloromethyl)benzene (p-Xylylene dichloride)	98-100	240-5								Heating with benzyl alcohol +KOH → dibenzyl ether, 67, Boiling with Pb(NO <sub>3</sub> ) <sub>2</sub> → terephthaldehyde, 115
9	Triphenylmethyl chloride (Trityl chloride)	113									Boiling with H <sub>2</sub> O → triphenyl carbinol, 162

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### A) Alkyl and cycloalkyl halides 2. Bromides

### a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, *C	n <sub>D</sub> <sup>20</sup>	D2º	S-Alkyl thiuronium picrate	l Naph thyl amide	Anılıde	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitro phenyl thioether	2,4-Dinitro- phenyl sulfone	Miscellaneous
1	Methyl bromide	3 5			224	160	114	172 160		128	185 189	
2	Vinyl bromide	16	i				104					Ì
3	Ethyl bromide	38	1 425	1 460	188	126	104	193 198	104	115	156, 160	•
4	1-Вготоргорепе	60	1 452	1 4133			114		]			
5	Isopropyl bromide	60	1 425	1 314	196,148	ł	103	93	92	95	140	1
6	Allyl bromide	71	1 46545	1 398	155	1	114		99	71		
7	n-Propyl bromide	71	1 4341	1 353	181, 177	121	92	138	75	84	126	Ī
8	tert-Butyl bromide	72 3		1 211		147	128		;			
9	Isobutyl bromide	91	1 435	1 253	174 167	125	109	55	84	76	105	:
10	sec-Butyl bromide	91	1 437	1 256	190, 166	129	108	39	85	66	120	ļ
11	n-Butyl bromide	101	1 440	1 274	180, 177	112	63	136, 129	67	66	92	
12	tert-Amyl bromide	108	1 442	1 19818		138	92					
13	Neopentyl bromide	109		1 225			126					
14	DL-2-Pentyl bromide	117, 113	1 442	1 212		102 3	93					
15	3-Pentyl bromide	118	1 443	1 211			124					
16	Isoamyl bromide	120-1	1 442	1 213	179, 173	111	108	80	1	80	124	
17	n-Amyl bromide (n-Pentyl bromide)	129	1 445	1 219	154	112	96	127, 122	67	80	83	
18	Cyclopentyl bromide	137	1 489	1 387								
19	2-Hexyl bromide (2-Bromo- hexane)	146	1 483225	1 1658			91-2					
20	n-Hexyl bromide	155 157	1 448	1 175	157	106	69	127 119		74	97	
21	Cyclohexyl bromide	165	1 495	1 336		188	146	153				
22	n-Heptyl bromide	180 174	1 451	1 140	142	95	57	118		82	101	
23	Benzyl bromide	198		1 438	188	166	117	119	123	130	178, 182	
24	n-Octyl bromide	201, 204	1 453	1 112	134	91	57	109		78	98	
25	α-Phenylethyl bromide	205					133			-		
26	$\beta$ -Phenylethyl bromide	218	1 556	1 359			97	169	84			
27	n-Nonyl bromide	220	1 454	1 090	131			109		86	92	
28	$\beta$ -Bromostyrene	221				217	115	91				
29	n-Dodecyl bromide (Lauryl bromide)	1306	1 458	1 038				108				
20	n-Tetradecyl bromide	17920	1 460	1 017						94	104	m p 5

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

A) Alkyl and cycloalkyl halides 2. Bromides

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, *C	Boiling point, °C	S-Alkyl thiuronium picrate	I-Naph- thyl amide	Amlide	Alkyl mer- curic halide	Picrate of 2-naph- thyl ether	2,4-Di nitro- phenyl thio- ether	2,4-Di- nitro- phenyl sulfone	Miscellaneous
1	n-Hexadecyl bromide (Cetyl bromide)	14	2019	155, 137			101 2		95	105	n <sub>D</sub> <sup>20</sup> 1 462, D <sub>4</sub> <sup>20</sup> 1 001
2	2-Bromobenzyl bromide	31		222							CrO <sub>3</sub> → 2-bromobenzoic acid, 150
3	3-Bromobenzyl bromide	41		205				ļ			CrO <sub>3</sub> → 3-bromobenzoic acid, 155
4	2-Nitrobenzyl bromide	46-7				ŀ	l	•			Oxid → 2-nitrobenzoic acid, 146-8
5	4-Chlorobenzyl bromide	51		194							CrO <sub>3</sub> → 4-chlorobenzoic acid, 242
6	3-Nitrobenzyl bromide	58-9				<u> </u>	l	l			Oxid → 3-nitrobenzoic acid, 141
7	4-Bromobenzyl bromide	62		219							CrO <sub>3</sub> → 4-bromobenzoic acid, 251
8	4-Nitrobenzyl bromide	99									Oxid → 4-nitrobenzoic acid, 240

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### A) Alkyl and cycloalkyl halides 3. Iodides

a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D20	S-Alkyl thiuronium picrate	1-Naph- thyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether		2,4-Dinitro- phenyl sulfone	Miscellaneous
1	Methyl iodide	43	1 532	2 282	224	160	114	152, 145	117	128	185, 189	
2	Vinyl iodide	56					104					
3	Ethyl iodide	72	1 514	1 940	188	126	104	186, 182	104	115	156, 160	
4	Isopropyl iodide	90	1 499	1 703	196, 148		103		92	95	140	
5	n-Propyl iodide	102-3	1 505	1 743	181, 176	121	92	113	75	84	126	
6	Allyl iodide	103	1 578	1 777	155	121	114	112	99		İ	
7	tert-Butyl iodide	103, 98			188	147	128					
8	sec-Butyl iodide	120	1 499	1 592	190, 166	129	108		85	66	120	
9	Isobutyl iodide	120	1 496	1 602	174, 167	125	109	72	84	76	105	
10	tert-Amyl iodide	128		1 479		138	92	1				
11	n-Butyl iodide	130	1 499	1 616	180, 177	112, 110	63	117	67	66	92	
12	2-Pentyl iodide	142	1 496	1 510	ì	i	93	ľ			1	
13	3-Pentyl iodide	142	1 497	1 511			124					
14	Isoamyl iodide	148	1 493	1 503	179, 173	111	108	122	94	80	124	
15	n-Amyl iodide (n-Pentyl 10dide)	155	1 496	1 512	154	112	96	110	67	80	83	
16	Cyclopentyl iodide	166-7	1 5447	1 7096	ŀ	Į.						
17	Cyclohexyl iodiđe	179, sl d		1 62615	}	188	146					
18	n-Hexyl iodide	179	1 493	1 437	157	106	69	110		74	97	
19	n-Heptyl iodide	204	1 490	1 373	142	95	57	103		82	101	
20	n-Nonyl iodide	220			131					86	92	
21	n-Octyl iodide	225-6	1 489	1 330	134					78	98	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

A) Alkyl and cycloalkyl halides 3. Iodides

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naph- thyl amide	Anilide		Picrate of 2-naphthyl ether		2,4-Dinitro- phenyl sulfone	Miscellaneous
	n-Hexadecyl iodide (Cetyl 10d1de) Benzyl iodide	22 24		155, 137 188	166	117	82	123	95 130	105 178, 182	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### B) Dihalides and polyhalides (non-aromatic)

### 1. Fluorides (Listed in order of increasing atmospheric b.p.)\*

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<sup>\*</sup>Derivative data given in order in p , crystal color, solvent from which crystallized

B) Dihalides and polyhalides (non-aromatic)

2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	n D	D <sub>4</sub> <sup>20</sup>	Miscellaneous
1	Dichloromethane (Methylene chloride)	41	1 4237	1 336	6-Nitro-2-mercaptobenzothiazole deriv , 232-3, Di-(2-naphthyl) ether, 133 S-Alkyl bis-(thiuronium picrate), 267
2	trans-1,2-Dichloroethylene	48	1 452	1 2569	Br <sub>2</sub> → dibromo deriv, 190 5
3	1,1-Dichloroethane	57	1 4164	1 175	1,1-D1-(1-naphthyl)ether, 117
4	cis-1,2-Dichloroethylene	60	1 442825	1 282	Br <sub>2</sub> → dibromo deriv, 190-5
5	Chloroform	61	1 446	1 489	Gives carbylamine test with primary amines
6	2,2-Dichloropropane	70	1 4117	1 093	
7	1,1,1-Trichloroethane	74	1 4380	1 349	
8	Carbon tetrachloride	77	1 4630	1 595	
9	Ethylene dichloride (1,2-Dichloroethane)	84	1 4443	1 256	1 2-Di-(2-naphthyl)ether 217
10	1,1,2-Trichloroethylene	87	1 4773	1 464	HgO + NaOEt + KCN in al shaken l hr at 40 60 → mercury bis-(trichloroethylenide), Hg(—CCl=CCl <sub>2</sub> ) <sub>2</sub> , 83, eth
11	1,2-Dichloropropane	96	1 4388	1 155	1,2-Di-(2-naphthyl)ether, 152, 1,2-Diphenyl ether, 32
12	1-Bromo-2-chloroethane	106-7			6-Nitro-2-mercaptobenzothiazole deriv , 202 3 Di-(2-naphthyl)ether, 217
13	1,1,2-Trichloroethane	114	1 4707	1 443	
14	1,1,2,2-Tetrachloroethylene (Perchloroethylene)	121	1 5055	1 623	With paraformaldehyde + conc $H_2SO_1 \rightarrow \alpha, \alpha$ -di- chloro- $\beta$ -hydroxypropionic acid 88 9
15	1,2-Dichlorobutane	123-4	1 440		6-Nitro-2-mercaptobenzothiazole deriv, 164-5
16	1,3-Dichloropropane	125	1 449	1 189¦* 1 177 <sub>4</sub> °	1,3-Di-(1 naphthyl)ether, 103-4   3-Di-(2-naphthyl) ether 148 9 1,3-Diphenylether 60
17	1,3-Dichloro-2-methylpropane	135 6	1 462719	1 13120	
18	1-Bromo-3-chloropropane	143 4	1 4861	1 594	1,3-Di-(1-naphthyl) ether, 103-4 1,3-Di-(2-naphthyl) ether, 148-9 1,3-Diphenyl ether, 60
19	1,1,2,2-Tetrachloroethane	146	1 4942	1 600	
20	1,2,3-Trichloropropane	158	1 4585	1 417	
21	Pentachloroethane	161	1 504	1 681	
22	Benzalchloride	207, 214	1 5515	1 29516	Oxid → benzoic acid, 122, Hydrolysis → benzaldehyde, 2,4-Dinitrophenylhydrazone 237, Semicarbazone, 222
23	Benzotrichloride	221		1 37417	Hydrolysis → benzoic acid, 122
24	2-Chlorobenzalchloride (2-Chlorobenzylıdene chlorıde)	228-9	1 567016	1 399 \$	Oxid → 2-chlorobenzoic acid, 141 Hydrolysis → 2-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 213 209
25	3-Chlorobenzalchoride (3-Chlorobenzylidene chloride)	237–40			Oxid 3-chlorobenzoic acid, 158 Hydrolysis 3-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 256 248
26	4-Chlorobenzalchloride (4-Chlorobenzylidene chloride)	237			Oxid $\rightarrow$ 4-chlorobenzoic acid, 240, Hydrolysis $\rightarrow$ 4-chlorobenzaldehyde, 47 2,4-dinitrophenylhydrazone, , 265

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# B) Dihalides and polyhalides (non-aromatic) 2. Chlorides b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	3,4-Dichtorobenzotrichloride	26	1	Hydrolysis → 3,4-Dichlorobenzoic acid, 202
2	DDT (2,2-Bis-(4-chlorophenyl)-1,1,1-trichloroethane)	108	260	Heating with $Cl_2$ + trace $PCl_3$ in $CCl_4 \rightarrow 1,1,1,2$ -tetrachloro deriv, 91-2, Nitration $\rightarrow$ nitro deriv, 148, AlCl <sub>3</sub> + benzene $\rightarrow$ 1,1,2,2-tetraphenylethane, 211
3	γ-Benzene hexachloride (Gammexane, 666)	112		
4	lpha-Benzene hexachloride	157	288	Heat above m p → HCl + 1,2,4-trichlorobenzene, 17, b p 213, mononitro deriv, 56, dinitro, 103
5	Hexachloroethane	187 subl	185	
6	β-Benzene hexachloride	310		Unreactive to boiling pyridine, Unattacked by boiling HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub>

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

B) Dihalides and polyhalides (non-aromatic)

3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	n <sup>20</sup>	D <sub>4</sub> 20	Miscellaneous
1	Dibromomethane (Methylene bromide)	98~9	1 538	2 496	6-Nitro-2-mercaptobenzothiazole deriv , 232 3, S-Alkyl bis-(thiuronium picrate), 267
2	1,1-Dibromoethane	112	1 5128	2 055	6-Nitro-2-mercaptobenzothiazole deriv, 145 6 1,1-Di-(1 naphthyl) ether, 117
3	1,2-Dibromoethane	132	1 5379	2 179	m p 10, 6-Nitro-2-mercaptobenzothiazole deriv 201 2 1,2-Di-(2-naphthył) ether 217
4	DL-1,2-Dibromopropane	141-2	1 5203	1 933	6-Nitro-2-mercaptobenzothiazole, 194 5, 1 2-Di-(2-naphthyl) ether, 152, 1,2- Diphenyl ether, 32
5	1,2-Dibromo-2-methylpropane	149	1 512	1 783	
6	1,2-Dibromo-1-butene	150		1 887	
7	Bromoform	150-1	1 598	2 890°	m p 8
8	1,3-Dibromopropene	156	1 53825	2 097"	
9	1,1-Dibromo-2-methylpropene	156 7	1 530	1 86620	
10	2,3-Dibromobutane	157	1 515	1 792	
11	1,2-Dibromobutane	166		1 820	6-Nitro-2-mercaptobenzothiazole deriv, 164 5
12	1,3-Dibromopropane	167 8	1 523	1 982	1,3-Di-(1-naphthyl)ether, 103-4   3 Di-(2-naphthyl)ether   148 9 1,3-Diphenyl ether, 60
13	1,3-Dibromo-2-butene	168-9	1 548	1 877	
14	1,3-Dibromobutane	174	1 507	1 820°	
15	1,1,2-Tribromoethane	189	1 5933	2 6211	h
16	1,4-Dibromobutane	197-8		1 847°	p-toluidine (3 moles) heat N-4 tolylpyrrolidine, 42 dil al
17	1,2,3-Tribromopropane	220	1 582	2 402	•
18	1,5-Dibromopentane	221	1 51415	1 69445	6-Nitro-2-mercaptobenzothiazole deriv , 132 3 S-Alkyl bis-(thiuronium picrate) 247
19	1,1,2,2-Tetrabromoethane	243-4	1 638	2 967	
20	1,8-Dibromooctane	270-2	1 501 15	1 46815	m p 15-6, S-Alkyl bis-(thiuronium picrate), 214
21	1,9-Dibromononane	285-8		1 41515	m p -2 5, S-Alkyl bis-(thiuronium picrate), 193

 $<sup>^\</sup>bullet \textbf{Derivative}$  data given in order  $\,m\,\,p$  , crystal color, solvent from which crystallized

B) Dihalides and polyhalides (non-aromatic)

3. Bromides b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point °C	Miscellaneous
			263 190	S-Alkyl bis-(thiuronium picrate), 208

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

B) Dihalides and polyhalides (non-aromatic)

4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	n 20	D2º	Miscellaneous
ı	Di-iodomethane (Methylene 10dide)	181	1 7425	3 325	6-Nitro-2-mercaptobenzothiazole deriv, 232, 3, Di-(2-naphthyl) ether, 133, S-Alkyl <i>bis</i> -(thiuronium picrate), 267
2	1,3-Di-iodopropane	224	1 6423	2 5755	1,3-Di-(1-naphthyl) ether, 103-4, 1,3-Di-(2-naphthyl) ether, 148-9, 1,3-Di-henyl ether, 60

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

B) Dihalides and polyhalides (non-aromatic)
4. Iodides b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point, °C	l
1	1,2-Di-iodoethane	81		6-Nitro-2-mercaptobenzothiazole deriv, 202 3, 1,2-Di-(2-naphthyl) ether, 217
2	lodoform	119		Comp with quinoline, 65

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE V. ORGANIC DERIVATIVES OF HALIDES C) Aryl halides 1. Fluorides (Listed in order of increasing atmospheric b.p.)\*

						Nitro	derivative	Sulf	onamide	
No	Name	Boiling point, °C	Melting point °C	n 20	D2º	МР	Position of nitro groups	МР	Position of sulfona- mide group	Miscellaneous
1	1,3-Difluorobenzene	82		1 440418	1 147325	74	1 3			
2	Fluorobenzene	87		1 466	1 024			125	4	
3	1,4-Difluorobenzene	88		1 442318	1 163225					Boiling with NaOH → 4-fluorophenol, 48, b p 186-8, n. 56 1 5010, D. 56 1 1889
4	1,2-Difluorobenzene	92	-34	1 4451 18	1 149625				1	1 100
5	2-Fluorotoluene	114						105	5	Oxid → 2-fluorobenzoic acid, 127
6	3-Fluorotoluene	116				ł		174	6	Oxid - 3-fluorobenzoic acid, 124
7	4-Fluorotoluene	117		1 496	0 998			141	2	Oxid - 4-fluorobenzoic acid, 182
8	1-Fluoronaphthalene	214		1 594	1 134					Picrate, 113
9	2-Fluoronaphthalene		60							Picrate, 101

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## · C) Aryl halides 2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

_						Nitro	derivative	Sulfe	namide	
No	Name	Boiling point, °C	Melting point, °C	n <sup>20</sup>	D₽º	МР	Position of nitro groups	МР	Position of sulfona mide group	Miscellaneous
1	Chlorobenzene	132		1 525	1 107	52	2,4	144	4	2,4-Dinitrobenzenesulfenyl chloride adduct, 123 4
2	2-Chlorotoluene	159		1 524	1 082	63	3,5	128	5	Oxid → 2-chlorobenzoic acid, 141
3	3-Chlorotoluene	162		1 521	1 002	91	4,6	185	6	Oxid → 3-chlorobenzoic acid, 158
4	4-Chlorotoluene	162	7	1 521	1 071	38	2	143	2	Oxid → 4-chlorobenzoic acid, 240
5	1,3-Dichlorobenzene	173	l .	1 546	1 288	103	4,6	182	6	
	1-Chloro-2-ethylbenzene	178, 180		1 5218	1 057	1	i ''-		ľ	Oxid → 2-chlorobenzoic acid, 141
7	1,2-Dichlorobenzene	179		1 552	1 305	110	4,5	135, 140	4	
8	1-Chloro-3-ethylbenzene	184		1 5199	1 053	İ	ŀ	140		Oxid → 3-chlorobenzoic acid, 158
	1-Chloro-4-ethylbenzene	184, 180-1		1 5175	1 045					Oxid → 4-chlorobenzoic acid, 240
10	2-Chloro-1,4-dimethyl- benzene	184-5	2		1 05920	77, 101	5, 5,6	155	5	Sulfonyl chloride, 50
11	1-Chloro-2-vinylbenzene (o-Chlorostyrene)	189		1 5649	1 100					Polymerizes on heating with benzoyl peroxide
12	1-Chloro-2,3-dimethyl- benzene	190								Oxid → 3-chloro-2-methylbenzoic acid,
13	1-Chloro-2-isopropyl- benzene	191		1 5168	1 0341					Oxid → 2-chlorobenzoic acid, 141
14		192, 187		1 5230 <sup>25</sup>	1 059828	42	6	195	6	Oxid CrO <sub>3</sub> /H <sub>2</sub> SO <sub>4</sub> 4-chloro-3- methylbenzoic acid, 209 10, Oxid aq KMnO <sub>4</sub> 4-chloroisophthalic
15	1-Chloro-4-vinylbenzene (p-Chlorostyrene)	192		1 5660	1 0868					Polymerizes on heating with peroxide
16	1-Chloro-3,4-dimethyl- benzene	194-5	-6		1 06915	63	5	207	5	Cl <sub>2</sub> − Fe 1,2-dichloro-4 5-dimethylbenzene, 76
17	1-Chloro-4-isopropyl- benzene (p-Chloro- cumene)	198		1 5117	1 0208			91		Oxid → 4-chlorobenzoic acid, 240
18	2,6-Dichlorotoluene	199		1 5510	1 2686	50, 121	3, 3,5			Chlorosulfonic acid in chl → 3-sulfonyl chloride 54 6, 60 Oxid → 2,6-di-chlorobenzoic acid 139
19	2,5-Dichlorotoluene	199	4-5		1 253528	50 1, 100-1	4, 4,6			Oxid dil HNO <sub>3</sub> 2,5-dichlorobenzoic acid, 154
	2,4-Dichlorotoluene 3,5-Dichlorotoluene	200 201		1 549	1 249	104 61 2,	3,5	168 9	2	Oxid → 2,4-dichlorobenzoic acid, 164 Oxid → 3,5-dichlorobenzoic acid, 188
2.	5,5-Dicinolototache	201				99- 100	2,6	100 )		
22	2-Chloro-1,3,5-trimethyl- benzene	204-6		1 521230	1 033730	178	4,6	165-6		Oxid Aq KMnO. 2-chlorobenzene tricarboxylic acid, 285 (anh ), 278 (hyd )
23	2,3-Dichlorotoluene	207		1 5511		51, 71-2	4, 4,6			Oxid alk KMnO <sub>4</sub> 2,3-dichloro-
24	3,4-Dichlorotoluene	209		1 5471	1 2526	63, 91-2	6, 2,6			Oxid → 3,4-dichlorobenzoic acid, 206
25	1,2,4-Trichlorobenzene	213	17			56, 103	5, 3,5	> 200		Sulfonyl chloride, 31-4
26	2-Chloro-4-isopropyl-1- methylbenzene (2- Chloro-p-cymene)	217		1 517817	1 01517	109-10				Boiling with dil HNO <sub>3</sub> → 3-chloro-4- methylbenzoic acid, 196
27	3-Chloro-4-isopropyl-1- methylbenzene (3- Chloro-p-cymene)	217		1 517918	1 01848	102-3, 106	2,6			
28 29	1-Chloronaphthalene 3-Chlorobiphenyl	259 284-5	16	1 633	1 191	180 202-3	4,5 4,4'			Picrate, 137 Oxid → 3-chlorobenzoic acid, 158, 155

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE V. ORGANIC DERIVATIVES OF HALIDES C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)\*

		<u> </u>	<del>                                     </del>	Nitro	derivative	Sulfo	namide	
No	Name	Melting point, °C	Boiling point, *C	мР	Position of nitro groups	МР	Position of sulfona- mide group	Miscellaneous
1		29	283					Hydrolysis → 2-chlorobenzoic acid, 142
2	2,4,6-Trichlorotoluene	33 4, 38		54 50 178 80	3,			Oxid → 2,4,6-trichlorobenzoic acid,
3		34	273		1.			Oxid → 2-chlorobenzoic acid, 141
4	1,2-Dichloronaphthalene	35	296	169	dı			n <sup>48</sup> 1 6337, D <sup>48</sup> 1 3147 Oxid CrO <sub>3</sub> /ac a naphthoquinone, 181
5	2,3,4-Trichlorotoluene	41	231761	60, 140-1	5 or 6, 5,6	ļ		Oxid> 2,3,4-trichlorobenzoic acid, 186-7
6	1,2,3,4-Tetrachlorobenzene	44-5	254	63 5, 151	5,			
7	3,4,5-Trichlorotoluene	44-5	245768	81 2, 163-4	2, 2,6			Oxid $\rightarrow$ 3,4,5-trichlorobenzoic acid, 203, Cl <sub>2</sub> $\xrightarrow{\text{Al/Hg}}$ 2,3,4,5-tetrachlorotoluene, 97-8
8	2,3,5-Trichlorotoluene	45-6	232	58 9,	4 or 6,			Oxid dil HNO <sub>3</sub> 2,3,5-trichloroben-
٥	1,6-Dichloronaphthalene	48	Ì	149-50 119	4,6 4	216	4	zoic acid, 162
	1,2,3,5-Tetrachlorobenzene	50-1	246	40-1,	4,	210		
11	1,2,3-Trichlorobenzene	52 3	218-9	161-2 56, 92-3	4,6 4, 4,6	226-30	4	Sulfonyl chloride, 65
ኣ 12	1,4-Dichlorobenzene	53	173	54	2	180 186	2	C-0 /
13	4,4'-Dichlorodiphenylmethane	55	337	198-9	3,3'			Oxid CrO <sub>3</sub> /ac a 4,4'-dichloro- benzophenone, 145
	2-Chloronaphthalene 2,2'-Dichlorobiphenyl	56, 61 60	265	175 203-5	1,8 5,5'	126		Picrate, 81
16	1,3-Dichloronaphthalene	61	291775	150 and 158	dı			Oxid — phthalic acid, 200-6
17	1,3,5-Trichlorobenzene	63	208	68	2	210 2		Sulfonyl chloride, 35-40
18 19	1,7-Dichloronaphthalene 1-Bromo-4-chlorobenzene	63–4 67	286 197	138-9 72	2	226	4	Sulfonyl chloride, 118
20	1,4-Dichloronaphthalene	68	286740	92	8	244	6	Oxid CrO <sub>3</sub> /ac a 5,8-dichloro-1,4-
								naphthoquinone, 173 4 Boiling HNO <sub>3</sub> (D = 1 3) → 3 6-dichloro- phthalic acid, 194 185
21	<b>2,5-Dichloro-1,4-dimethylbenzene</b> (2,5-Dichloro <i>p</i> -xylene)	68	224					Oxid → 2,5-dichloroterephthalic acid, 306
22	4-Chlorobiphenyl	77	293					Oxid → 4-chlorobenzoic acid, 240
23	2,4,5-Trichlorotoluene	82	230715	89-90, 226 7	3,			Oxid → 2,4,5-trichlorobenzoic acid, 168
24 25	Pentachlorobenzene 1,8-Dichloronaphthalene	86, 84 89	276		6	228	4	Sulfonyl chloride, 141
	1,5-Dichloronaphthalene	107		142	8	204		Oxid CrO <sub>3</sub> /ac a 3-chlorophthalic
٦٧	1,0 2,0,0,0,0,0,0,0,0,0,0							acid, 185 7 Picrate, 87
27	2,7-Dichloronaphthalene	114 5		141 2	mono	218	3	Oxid — 4-chlorophthalic acid, 157
28	2,6-Dichloronaphthalene	1356	285			269	4	Sulfonyl chloride, 136, Cl₂ in chl → 1,2, 6-trichloronaphthalene, 92 Oxid CrO₁/ac a
								deriv 148 9
29	1,2,4,5-Tetrachlorobenzene	140	245	99, 232	3, 3,6			Chlorosulfonic acid → hexachloro- benzene, 229
30	4,4'-Dichlorobiphenyl	149			5,5			Oxid → 4-chlorobenzoic acid, 240

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE V. ORGANIC DERIVATIVES OF HALIDES C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)\* (Continued)

		14-1		Nitro d	lerivative	Sulfo	namide	
No	Name	Melting point, *C	Boiling point, *C	МР	Position of nitro groups	МР	Position of sulfona- mide group	Miscellaneous
31	5,6,7,8-Tetrachlorotetralin	174	18026					Br <sub>2</sub> in CS <sub>2</sub> → 1,2-dibromo-5,6,7,8-tetra- chloronaphthalene, 142
32	1,2,3,4-Tetrachlorotetralin	182, 187						Oxid CrO <sub>3</sub> /ac a 2,4-dichloro-1-naphthol, 106-7 Boiling HNO <sub>3</sub> -> phthalic acid, 200-6
33	Octachioronaphthalene	198, 200	442					Oxid fuming HNO <sub>3</sub> hexachloro-1,4- naphthoquinone, 222 SbCl <sub>3</sub> in CCl <sub>4</sub> → cherry-red color
34	9,10-Dichloroanthracene (meso-D1-	209-10,			[	279	2	Sulfonyl chloride, 221-5, Oxid $\rightarrow$ 9,10-
	chloroanthracene)	yel						anthraquinone, 286, Maleic anh adduct, 258 9
35	Hexachlorobenzene	229, subl , 226	309					Boiling with fuming HNO <sub>3</sub> + conc H <sub>2</sub> SO <sub>4</sub> → tetrachloro-1,4-benzoquinone (chloroanil), 290

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE V. ORGANIC DERIVATIVES OF HALIDES C) Aryl halides 3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

		Τ				Nitro	derivative	Sulf	onamide	
No	Name	Boiling point, *C	Melting point, *C	n <sub>20</sub>	D‡º	M P	Position of nitro groups	МР	Position of sulfona- mide group	Miscellaneous
1	Bromobenzene	156		1 560	1 494	70–2	2,4	166 161	4	I-Naphthylamide, 161, 2,4-Dinitroben- zenesulfenyl chloride adduct 140-1
2	2-Bromotoluene	182			1 425	82	3,5	146	5	Oxid → 2-bromobenzoic acid, 150
3 !	3-Bromotoluene	184			1 410	103	4,6	168	6	Oxid → 3-bromobenzoic acid, 155
4	1-Bromo-2-ethylbenzene	199		1 5486	1 355					Oxid → 2-bromobenzoic acid, 150
5	1-Bromo-4-ethylbenzene	205		1 5448	1 342	ł				Oxid → 4-bromobenzoic acid, 251
6	1-Bromo-2-vinylbenzene (o- Bromostyrene)	210		1 5927	1 4160					Polymerizes on heating with benzoyl peroxide
7	1-Bromo-2-isopropylbenzene	210	,	1 5408	1 3020	ł				Oxid → 2-bromobenzoic acid, 150
8	1-Bromo-4-vinylbenzene (p-Bromostyrene)	212		1 5947	1 398					Polymerizes on heating with benzoyl peroxide, Oxid → 4-bromobenzoic acid, 251
9	1-Bromo-2,3-dimethylbenzene	217	<b> </b>		1	1	1	1	1	Oxid → 3-bromophthalic acid, 188
10	1,3-Dibromobenzene	219		1 606	1 952	61	4	190	6	
11	1-Bromo-4-isopropylbenzene	219	į	1 5361	1 2854				İ	Oxid → 4-bromobenzoic acid, 251
12	1,2-Dibromobenzene	219		1 609	1 956	114	4,5	176	4	
13	2-Bromocymene	234			1 267	97	-			Anılıde, 143
14	2,5-Dibromotoluene	236			1811					Oxid → 2,5-dibromobenzoic acid, 157
15	3,4-Dibromotoluene	240			181					Oxid → 3,4-dibromobenzoic acid 235
16	1-Bromonaphthalene	281		1 658	1 484	85	4	191 3	4	Picrate, 134, Carbonation of Grignard → 1-naphthoic acid, 162
17	2-Bromobiphenyl	297					1			Oxid → 2-bromobenzoic acid, 150

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE V. ORGANIC DERIVATIVES OF HALIDES C) Aryl halides 3. Bromides b) Solids (Listed in order of increasing m.p.)\*

	Melting Boiling		Nitro	derivative	Sulf	onamide		
No	Name	point,	point,	мР	Position of nitro groups	мР	Position of sulfona- mide group	Miscellaneous
1	4-Bromotoluene	28-9	184					Oxid → 4-bromobenzoic acid, 251
2	2-Bromonaphthalene	59	281			208	8	Picrate, 86, 79, 2,4,7-Trinitrofluorenone adduct, 138-40
3	1,2-Dibromonaphthalene	67			ĺ			Oxid → 3,4-dibromophthalic acid, 196
4	1,4-Dibromonaphthalene	82				ļ	1	Oxid → 3,6-dibromophthalic acid, 135
5	1,4-Dibromobenzene	89	219	84	2,5	195	2	
6	4-Bromobiphenyl	89	310		<b>[</b>	[		Oxid → 4-bromobenzoic acid, 251
7	1,3,5-Tribromobenzene	120	271			222	2	
8	4,4'-Dibromobiphenyl	164			1			Oxid → 4-bromobenzoic acid, 251
9	1,2,4,5-Tetrabromobenzene	180		168	3	]		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

C) Aryl halides 4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

						Nitro	derivative	Sulf	onamide	
No	Name	point *C	Melting point, *C	n <sub>D</sub> o	D₽	МР	Position of nitro groups	МР	Position of sulfona mide group	Miscellaneous
1 - 2 - 3 - 4 - 5 -	Iodobenzene 3-lodotoluene 2-Iodotoluene 1-Iodo-4-isopropylbenzene 1-Iodonaphthalene	188-7 204 211 236-8 305		1 620	1 831 1 698 1 698	108	4 4,6 6			Br <sub>2</sub> $\rightarrow$ 1-Bromo-4 iodobenzene 91 Oxid $\rightarrow$ 3-iodobenzoic acid, 187 Oxid $\rightarrow$ 2-iodobenzoic acid, 162 Cl <sub>2</sub> in chl $\rightarrow$ dichloride (ArICl <sub>2</sub> ) 110 Picrate, 128

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

## TABLE V. ORGANIC DERIVATIVES OF HALIDES C) Aryl halides 4. Iodides b) Solids (Listed in order of increasing m.p.)\*

		14-14	B1	Nitro	derivative	Sulf	onamide	
No	Name	Melting point, °C	Boiling point, °C	МР	Position of nitro groups	M P	Position of sulfona- mide group	
1	4-Iodotoluene	35	211					HNO <sub>3</sub> at 200° → 4-iodobenzoic acid, 270
2	1-Iodo-2,4,5-trimethylbenzene	37	256-8	ŀ	1			Cl₂ in chl → dichloride (ArICl₂), 66
3	1,3-Di-iodobenzene	40	285	ļ				
4	2-Iodonaphthalene	55	309				ŀ	Picrate, 95
5	4-Iodobipheny!	114	320 d	[			1	Cl <sub>2</sub> in chl → dichloride (ArICl <sub>2</sub> ), 102
6	1,4-D1-iodobenzene	129	289	171	2,5			, , , ,
							1	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE VI**

Phenylurethane.

ROH + 
$$C_6H_5N=C=O \rightarrow C_6H_5NHCOOR$$

Phenylurethane (Phenylcarbamate)

From the dry alcohol with phenylisocyanate without solvent.

For directions and examples see: Linstead, pp. 34-35; Shriner, p. 211; Vogel, p. 264; B. T. Dewey and N. F. Witt, Ind. Eng. Chem., Anal. Ed., 12, 459 (1940); 14, 648 (1942).

From the dry alcohol with phenylisocyanate in petrol ether.

See: Wild, pp. 55-57.

I-Naphthylurethane (α-Naphthylcarbamate).\*

ROH + 
$$1-C_{10}H_7N=C=O \rightarrow 1-C_{10}H_7NHCOOR$$

1-Naphthylurethane (α-Naphthylcarbamate)

From the dry alcohol with 1-naphthylisocyanate without solvent.

For directions and examples see: Cheronis, pp. 475-479; Linstead, pp. 34-35; Shriner, p. 211; Vogel, p. 264; V. T. Bickel and H. E. French, J. Amer. Chem. Soc., 48, 747 (1926); H. E. French and A. F. Wirtel, J. Amer. Chem. Soc., 48, 1736 (1926).

From the dry alcohol with 1-naphthylisocyanate in petrol ether.

See: Cheronis, pp. 476-477; Wild, pp. 55-57.

p-Xenylurethane (4-Biphenylylurethane).

ROH + 
$$p$$
-C<sub>6</sub>H<sub>5</sub>C<sub>6</sub>H<sub>4</sub>N=C=O  $\rightarrow$   $p$ -C<sub>6</sub>H<sub>5</sub>C<sub>6</sub>H<sub>4</sub>NHCOOR

 $p$ -Xenylurethane

(4-Biphenylylcarbamate)

From the alcohol with p-xenylisocyanate in toluene.

For directions and examples see: G. T. Morgan and A. E. J. Pettet, J. Chem. Soc., 1124 (1931); B. Witten and E. E. Reid, J. Amer. Chem. Soc., 69, 2470 (1947).

From the alcohol with p-xenylisocyanate in a benzene—petrol ether mixture.

See: M. J. van Gelderen, Rec. Trav. chim., 52, 969 (1933).

p-Nitrobenzoate.\*

$$ROH + O_2N \longrightarrow COCI \rightarrow O_2N \longrightarrow COOR + HCI$$

From the alcohol in excess and p-nitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467-469, 471; Shriner, p. 212; Vogel, p. 263; Wild, p. 52; M. D. Armstrong and J. E. Copenhaver, J. Amer. Chem. Soc., 65, 2252 (1943).

From an aqueous solution of the alcohol with p-nitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468-469, 472.

From the alcohol with p-nitrobenzoyl chloride in pyridine.

See: Shriner, p. 212; Wild, p. 52; L. F. King, J. Amer. Chem. Soc., 61, 2383 (1939).

From the alcohol with p-nitrobenzoyl chloride in aqueous sodium hydroxide.

See: Wild, p. 52.

From the alcohol with p-nitrobenzoyl chloride in an aqueous solution of sodium acetate and potassium hydroxide at low temperature.

See: Wild, p. 53; F. A. Menalda, Rec. Trav. chim., 49, 967 (1930); H. Henstock, J. Chem. Soc., 216 (1933).

3,5-Dinitrobenzoate.\*

ROH + 
$$\frac{NO_2}{NO_2}$$
  $\frac{NO_2}{NO_2}$   $\frac{NO_2}{NO_2}$   $\frac{NO_2}{3,5-Dinitrobenzoate}$ 

\*Derivatives recommended for first trial.

### **EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)**

From the alcohol in excess with 3,5-dinitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467-470; Shriner, pp. 212-213; Vogel, p. 262; G. B. Malone and E. E. Reid, J. Amer. Chem. Soc., 51, 3424 (1929).

From an aqueous solution of the alcohol with 3,5-dinitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468-469, 472.

From the alcohol with 3,5-dinitrobenzoyl chloride and pyridine in benzene.

See: Linstead, p. 34; Wild, p. 53; T. Reichstein, Helv. chim. Acta, 9, 799 (1926); W. M. D. Bryant, J. Amer. Chem. Soc., 54, 3758 (1932).

From the alcohol with 3,5-dinitrobenzoyl chloride and a catalytic amount of pyridine in isopropyl or *n*-butyl ether.

See: Cheronis, pp. 469, 471.

From the alcohol with 3,5-dinitrobenzoyl chloride in pyridine.

See: Cheronis, p. 469; Shriner, pp. 212-213; Vogel, pp. 262-263.

From the alcohol with 3,5-dinitrobenzoyl chloride in aqueous potassium hydroxide.

See: Linstead, p. 34.

From the alcohol in aqueous sodium hydroxide and potassium acetate with 3,5-dinitrobenzoyl chloride in a benzene-ligroin mixture.

See: Wild, pp. 53-54; W. N. Lipscomb and R. H. Baker, J. Amer. Chem. Soc., 64, 179 (1942).

Hydrogen phthalate.\*

From the alcohol with phthalic anhydride.

For directions and examples see: E. E. Reid, J. Amer. Chem. Soc., 39, 1250 (1917); J. F. Goggans and J. E. Copenhaver, J. Amer. Chem. Soc., 61, 2909 (1939).

From the alkoxymagnesium halide derived from a tertiary alcohol (prepared from the alcohol with ethylmagnesium bromide) with phthalic anhydride in ether or an ether-dioxan mixture.

See: W. A. Fessler and R. L. Shriner, J. Amer. Chem. Soc., 58, 1384 (1936).

Hydrogen 3-nitrophthalate.\*

ROH + 
$$COO$$
  $COOR$  +  $COOR$  +  $COOH$ 

Hydrogen 3-nitrophthalates (3-Nitrophthalic acid monoalkyl esters)

phthalate

From the alcohol with 3-nitrophthalic anhydride.

For directions and examples see: Cheronis, pp. 473-474; Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, J. Amer. Chem. Soc., 59, 1094 (1937); B. H. Nicolet and J. Sacks, J. Amer. Chem. Soc., 47, 2348 (1925); A. J. Veraguth and H. Diehl, J. Amer. Chem. Soc., 62, 233 (1940).

From a high boiling alcohol with 3-nitrophthalic anhydride in toluene.

See: Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, J. Amer. Chem. Soc., 59, 1094 (1937).

<sup>\*</sup>Derivatives recommended for first trial.

### **EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)**

Pseudosaccharin ether (Pseudosaccharin derivative).

From the alcohol with pseudosaccharin chloride without solvent.

For directions and examples see: Vogel, p. 266; Wild, pp. 60-61; J. R. Meadoe and E. E. Reid, J. Amer. Chem. Soc., 65, 457 (1943).

From the alcohol with pseudosaccharin chloride in chloroform.

See: H. Bohme and H. Opper, Z. Anal. Chem., 139, 255 (1953).

From the alcohol with pseudosaccharin chloride and a catalytic amount of pyridine in chloroform.

See: Cheronis, p. 482; H. Bohme and H. Opper, Z. Anal. Chem., 139, 255 (1953).

#### Allophanate

From the alcohol with cyanic acid (prepared from the depolymerization of cyanuric acid).

For directions and examples see: Linstead, p. 36; A. Behál, Compt. rend., 168, 945 (1919); M. A. Spielman, J. D. Barnes and W. J. Close, J. Amer. Chem. Soc., 72, 2520 (1950); H. W. Blohm and E. I. Becker, J. Amer. Chem. Soc., 72, 5342 (1950); Chem. Revs., 51, 471 (1952).

From the alcohol with sodium cyanate and dry hydrochloric acid in dioxane.

See: E. S. Lane, J. Chem. Soc., 2764 (1951).

#### Benzoate.\*

Especially for polyhydric alcohols.

From the alcohol with benzoyl chloride.

For directions and examples see: Shriner, p. 212.

From the alcohol with benzoyl chloride in anhydrous pyridine.

See: Cheronis, pp. 481-482; Shriner, p. 212; Vogel, pp. 243, 447.

From the alcohol with benzoyl chloride in aqueous sodium hydroxide.

See: Vogel, p. 447.

Acetate.

ROH + 
$$(CH_3CO)_2O \rightarrow CH_3COOR + CH_3COOH$$
  
R<sub>3</sub>COH +  $CH_3COCI \rightarrow CH_3COOCR_3 + HCI$   
Acetate

Especially for polyhydric alcohols.

From the alcohol with acetic anhydride and sodium acetate.

For directions and examples see: Linstead, pp. 35, 39; Shriner, p. 212.

From the alcohol with acetic anhydride in pyridine.

See: Shriner, p. 212.

From the alcohol (especially a tertiary alcohol) with acetyl chloride in the presence of magnesium.

See: A. Spassow, Chem. Ber., 70B, 1926 (1937).

NOTE: For additional information regarding directions and examples for the preparation of derivatives of polyhydric alcohols see explanations and references to Table XIX, p. 326.

### \*Derivatives recommended for first trial.

No	Name	Boiling point, °C	Melting point, *C	n 20	D2º	Phenyl- urethane	1 Naph thyl urethane	4 Nitro- benzoate	3,5- Dinitro- benzoate	Hydrogen 3-nitro- phthalate	Hydro- gen phthalate	Miscellaneous
1	Methanol (Methyl alcohol)	64 65	f p -97	1 330615	0 7915	47, al	124, lgr	96, dıl al	108 (cor),	153 (cor)	82 5 (cor)	Pseudosaccharin ether, 182 (cor)
2	Ethanol (Ethyl alcohol)	78 32	f p -117 3	1 3610	0 7894	52	79, lgr	57, al	93, al	158 (сог), w	48	Pseudosaccharin ether, 219 (cor)
3	2-Propanol (Isopropyl alcohol)	82 4	-89 5	1 37927	0 78507	75-6, lt pet	106	110 5, lt pet 108	123, pet eth	154 (cor), w		Pseudosaccharin ether, 137 (cor)
4	d,l-3-Buten-2-ol (Methyl vinyl carbinol)	94-6			:					43-4		Allophanate, 152, Constant boil mixt with 21 76% w . b p
5	2-Propen-1-ol (Allyl alcohol)	97 1		1 41345	0 8540	70	108	28	49-50	124		
6	1-Propanol (n-Propyl alcohol)	97 1		1 38499	0 80359	57, pet	80, 76	35, pet	74, pet eth	145 5 (cor), w	54 1-4 (cor), pet eth- bz	Pseudosaccharin ether, 124 5 (cor)
7	2-Butanol (d,l-sec-Butyl alcohol, Ethyl methyl carbinol)	99 5		1 3949525	0 80692	64 5, pet	97	25-6, dıl al	76	131 (cor)	(9 1) 59-60	Pseudosaccharin ether, 65 5 (cor)
8	2-Methyl-2-butanol (tert- Amyl alcohol)	102 3	-8 55	1 4052	0 80889	42, pet eth	72	85	116, 117-8			1
	2-Fluoroethanol 2-Methyl-1-propanol (Iso-	105 108 1		1 3633 <sup>25</sup>	0 80196	86, lgr	128 104	69	87	180 5	65, pet	Pseudosaccharın
	butyl alcohol) 3-Buten-1-ol	122 5-			0 00170	23 4-4 5				(cor)	eth	ether, 100 (cor)
	d,l-3-Methyl-2-butanol (sec-lsoamyl alcohol, d,l-lsopropyl methyl carbinol)	3 5 <sup>755</sup> 114, d 110-2		1 3973	0 8180	68	109			127	39, d 34, 1 34	$d [\alpha]_D^{20} + 5 34, \text{in}$
13	3-Pentanol (sym-sec-Amylalcohol, Diethyl carbinol)	116 1		1 4103	0 82037	48-9	95, lgr	17	101, 99, 97	121		
14	1-Butanol (n-Butyl alcohol)	117 6, 116	-90 2	1 397425	0 80960	61	71	70, 64 35–6	64, 62 5	147 (cor)	73 1- 5 (cor)	Pseudosaccharin ether, 96 (cor)
15	d,l-2-Pentanol (sec-Amyl alcohol)	119 85		1 4060	0 80919		74 5, 76, d 88- 91		62	102-3	60-1, d 34, l 34	Pseudosaccharin ether, 38 (cor)
16	3,3-Dimethyl-2-butanol (d,l-Pinacolyl alcohol, tert-Butyl methyl carbinol)	120 4	5 3	1 4148	0 8185	77-8, pet eth			107, yel - wh , pet		85-6, lt pet	
17	2,3-Dimethyl-2-butanol (Dimethyl isopropyl carbinol)	120 5	-14	1 4140	0 8208	65-6, pet eth	101		eth 111, yel, bz- pet			
18	3-Methyl-3-pentanol	123	-22	1 416625	0 8233445	43 5	83 5		eth 96 5, yel, pet eth, 62 5			Allophanate, 152 (cor)

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point *C	n <sup>20</sup>	D <sup>20</sup>	Phenyl urethane	I-Naph thyl urethane	4 Nitro benzoate	3,5- Dinitro- benzoate	Hydrogen 3-nitro- phthalate	Hydro- gen phthalate	Miscellaneous
19	2-Methyl-2-pentanol (Dimethyl n-propyl	123, 121	-103, -108	1 4113	0 81341				72			Benzoate, 182 3, al, Allophanate, 128
20	carbinol)  2-Methoxyethanol  (Methyl cellosolve,  Ethylene glycol mono-	124 5		1 40238	0 9647		1125 30	50 5, dıl al		129, dıl al		Diphenyl ure- thane, 51
21	methyl ether)  2-Methyl-3-pentanol (Ethyl isopropyl carbinol)	127 5		1 4168	0 82487	50	:		85, yel , pet eth	150 7	70 69 71, ra- cemic	
	1-Chloro-2-propanol 2-Methyl-1-butanol (Active amyl alcohol,	127 128 9		1 4107	0 8193	31	82, lgr		77 70	157 8, w		$[\alpha]_{\rm B}^{20} - 5.756$
24	d-sec-Butyl carbinol)  2-Chloroethanol (Ethylene chlorohydrin)	131				51	101			98		
25	d,l-4-Methyl-2-pentanol (Isobutyl methyl carbinol)	132		1 4011	0 80713	143, et ac	88	26	65, yel, pet eth			
26	3-Methyl-1-butanol (prim-Isoamyl alcohol)	132	-117	1 4085115	0 80918	56-7, lgr	68	21	61	166 3 (cor), 30% al 165-6,		Pseudosaccharin ether, 64 (cor)
27	d,l-2-Chloro-1-propanol	133 4		1 436	1 103				76	*		Alkalı + heat → propylene oxide b p 35
28	3-Methyl-2-pentanol (sec- Butyl methyl carbinol)	134 2749					72		43 5, yel , pet eth ,			35 S
29	2-Ethoxyethanol (Ethylene glycol monoethyl ether)	135		1 40797	0 9297		67 3- 5		75, al	118 8 6 (anh ), 94 2 4 (mono- hyd ) × -al		Diphenyl ure- thane, 43
30	3-Hexanol (Ethyl n- propyl carbinol)	136		1 4159	0 81851				97, yel - wh, pet eth	W-a1	76-7, pet eth	
31	2,2-Dimethyl-1-butanol (tert-Amyl carbinol)	136 7		1 4208	0 82834	65-6	80-1, lgr		per em	51, yel, pet eth		Pseudosaccharin ether, 68-9 lt pet
32	1-Pentanol (n-Amyl alcohol)	138 (cor )	-78 5	1 40994	0 81479	46	68	11	46 4	136 (cor)	75 5	Pseudosaccharın ether, 62 (cor )
33	d,l-2-Hexanol (n-Butyl methyl carbinol)	138 9745		1 412625	0 8097745		60 5	40	38 5		d 29	3,5-Dinitrophenyl urethane, 40
34	2,4-Dimethyl-3-pentanol	140		1 42259	0 8288	95, eth - pet eth , 96-9	95, 99	155		150-1		Camphor-like odor
35	Cyclopentanol	140 85		1 4530	0 94688	132 5, al	118					
36	2-lsopropoxyethanol (Ethylene glycol mono- isopropyl ether)	141 5 <sup>736</sup>		1 40954	0 9030							Triphenylmethyl ether, 71 0- 5, me al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point, °C	n D	D2º	Phenyl- urethane	l Naph thyl- urethane	4 Nitro benzoate	3 5- Dinitro- benzoate	Hydrogen 3-nitro phthalate	Hydro- gen phthalate	Miscellaneous
37	3-Ethyl-3-pentanol (Triethyl carbinol)	142		1 4305	0 83889							Camphor-like odor, Allo- phanate, 152 (cor)
38	2,3-Dimethyl-1-butanol	145		1 4195	0 829740 5	28 9			51 5, pa yel, pet eth			
39	3-Hydroxy-2-butanone (d./-Acetoin, Acetyl methyl carbinol)	145	-72	1 4178	0 986140				3			Semicarbazone, 185, al., 202, 2,4-Dinitro- phenylhydra- zone, 318, or , PhNO <sub>2</sub> -tol
40	1-Hydroxy-2-propanone (Acetol Acetyl car- binol)	146	-17	1 4295	1 082420							Semicarbazone, 196, al , 2,4-Di- nitrophenylhy- drazone, 128 5 (cor), or, al
41	2-Methyl-1-pentanol (2- Methyl-n-amyl alcohol)	148 0		1 4190	0 8208		75 6		50 5, yel, pet eth	145, 141, bz		
42	2-Ethylbutanol	148 9		1 4224	0 83345				51 5, pet eth			
43	2-Bromoethanol (Ethylene	149d					86					
44	bromohydrin)  2-n-Propoxyethanol  (Ethylene glycol mono- n-propyl ether)	150 0736		1 41328	0 9112							
45 46	Trichloroethanol 3-Methyl-1-pentanol	151 151~2 153 7 4 1	19	1 4188	0 8242	87	120 58 d,l 40-1, d 38- 40 l 37 8	71, al	142 3 38, yel pet eth			Urethane 64 5
47	4-Methyl-1-pentanol (Isoamyl carbinol Isohexyl alcohol)	152 3		1 4153	0 8131	48 (сог )	. 31 0		72, pet eth 69 8 (cor)	138 5 40, bz - pet eth		
48	d,l-4-Heptanol (D1-n propyl carbinol)	156	-41 5	1 4205	0 8183		78 80	٦5	64		60	
49		157 5	-51 6 -46 1	1 41778	0 81893	42	59 62	٩	58 4 (cor ), 60 1	124 (cor ), 123	25	Pseudosaccharin ether 60 (cor )
	d I-2-Heptanol (n-Amyl methyl carbinol, sec- Heptyl alcohol)	1587		1 4210	0 8167		54		49 4		57 5 d,I 76 5	
	2-Isobutoxyethanol (Ethylene glycol mono- isobutyl ether)	159 3746		1 41428	0 8900							
	2-sec-Butoxyethanol (Ethylene glycol mono-sec-butyl ether)	159 3746		1 41606	0 8966					_		
53	2,4-Dimethyl-1-pentanol	159 8		1 427	0 793					154-5, bz -pet eth		p-Xenylurethane, 74-5, pet

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

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No	Name	Boiling point, °C	Melting point, °C	n 20 D	D2º	Phenyl- urethane	I-Naph- thyl- urethane	4-Nitro- benzoate	3,5 Dinitro- benzoate	Hydrogen 3-nitro- phthalate	Hydro gen phthalate	Miscellaneous
54		161 2				38	76		77			
55	Chloropropyl alcohol) 2-Methyl-1-hexanol	164 5		1 4250	0 8270					131 2, wh,		p-Xenylurethane, 88 0- 5, pet
56	2-Ethyl-1-pentanol (2- Ethyl-n-amyl alcohol)	164 6								pet 127 8, bz - pet		p-Xenylurethane, 77-77 5, pet
57	d,l-4-Methyl-1-hexanol	165 173		1 4219	0 8239		50	<b>f</b>		149		Odor of Amyl alcohol
58	d,l-cis-2-Methylcyclo- hexanol (cis-Hexa- hydro-o-cresol)	165 3	-93	1 4640	0 9340	90 I 93 4		51 2 55 6	98 9		103 4 104 5	
59	4-Hydroxy-4-methyl-2- pentanone (Diacetone alcohol)	166			0 930625			48	55			Oxime, 57 5-8 5 lgr -eth
60	d,l-trans-2-Methyl- cyclohexanol (trans-Hexahydro-o- cresol)	167 4	21	1 4611	0 9235	105 mixt cis + trans		65 mixt cis + trans 35-6	114 5 mixt cus + trans 85 90		124 5 mixt cis + trans 95 6	
61	2-n-Butoxyethanol (Ethyl- ene glycol mono-n- butyl ether)	170-6743		1 417726	0 9188	62				1200 6		4-Nitrophenyl- urethane, 58 7 9 1, CCl <sub>4</sub>
62	2-Aminoethyl alcohol (Ethanolamine)	171										N-1-Naphthyl- urea, 186 (cor ) Picrate, 160
63	<b>2,6-Dimethyl-4-heptanol</b> (Di-isobutyl carbinol)	171 4 3 4		1 4242	0 812928	61 2, lgr-al					118	p Xenylurethane, 118 Allo- phanate, 156
64	Furfuryl alcohol (2-Furyl carbinol)	172, 170		1 4863	1 135120	45	129 30, lgr, 133	76	80 1		85	Urethane, 50, Pseudosaccharin ether 55
65	d,l-cis-3-Methylcyclo- hexanol (cis-Hexa- hydro-m-cresol)	173 4		1 4572	0 919	87 8	128 9	65	91 2		82-3	5
66	d,l-cis-4-Methylcyclo- hexanol (cis-Hexahydro- p-cresol)	173 4 <sup>750</sup>		1 4549	0 914	118 9		94	134		72 3	
67	d.l-trans-4-Methylcyclo- hexanol (trans-Hexa- hydro-p-cresol)	173 4 5 <sup>74</sup>		1 4534	0 913	124 5, mixt cis + trans 112 5		67	139 40, mixt cis + trans 125 30		119-25, ac a	
68	d,l-trans-3-Methylcyclo- hexanol (trans-Hexa- hydro-m-cresol)	174 5		1 4550	0 9145	93 4 mixt cis + trans 75 85	122	58	97 8, mixt cis + trans 80 5		93 4	
69	2,6-Dimethylcyclohexanol	174-5748		1 4619	0 9115, 0 9235	158			50 5			
70	cis-2,5-Dimethylcyclo- hexanol	175		1 452214	0 9096¦-							Allophanate,
71	trans-2,4-Dimethylcyclo- hexanol	175		1 4560	0 900	96			ļ			Acetate, b p
72	1,3-Dichloro-2-propanol	176				73	115			į		

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\,$ m  $\,$ p , crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point °C	л <sup>20</sup> D	D‰	Phenyl urethane	l Naph thyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydro- gen phthalate	Miscellaneous
73	3-Bromo-1-propanol (Triethylene bromo-	176d					73					
74	hydrin) cis-2,4-Dimethylcyclo-	176		1 4582	0 907							
75	hexanol 1-Heptanol (n-Heptyl alcohol)	176 8	-34 6 -33 8	1 4245	0 82242	60 65	62	10	46 47	127 (cor )	16 5- 17 5	Pseudosaccharin ether, 55 (cor )
76	trans-2,5-Dimethylcyclo-	177	-33 6	1 454517	0 9079¦7					(601)	1, 3	Allophanate, 125
77	2,2-Dimethylcyclohexanol	177	8	1 4648	0 9225	85	ł	ł		ł	l	ł
78	Tetrahydrofurfuryl alcohol	177-8,43	1	1 45167	1 0544	61, pet eth		46–8	83-4			Diphenylurethane, 81, me al
79	2-Methyl-1,2-propanediol	178		1 435817	0 999¼	bis						
80	(Isobutylene glycol)  d,l-2-Octanol	179		1 4265	0 8205	140 5 oil	63-4, 62 5	28	32		5 <b>5</b> , <i>d</i> , <i>l</i>	
81	2,2-Dibromoethanol	179-81					02 3				'3	Urethane 90-1
	1,3,5-Trimethylcyclo- hexanol	181		1 454163	0 887648 8						:	
83	2,3Butanediol (2,3-Butylene glycol)	meso 181 7 +², d,l 176 7 +²	meso 34 4, d,l 7 6	meso 1 43637	meso 1 0433	meso bis 201						Dibenzoate d,l 53 4, meso 75 5-6 2
84	Cyclohexyl carbinol (Hexahydrobenzyl alcohol)	182		1 4649	0 9280							Acetate, b p 199-201 <sup>740</sup>
85	2,3-Dichloropropanol	182				73	93	37-8				2-Naphthylure- thane, 99
86	4-Methyl-1-heptanol	182 7			]					133		Pseudosaccharin ether, 34 (cor)
87	2-Ethyl-1-hexanol	184 6		1 4328	0 8328	33-4	60 1			108		p-Xenylurethane, 80, pet, Pseudo- saccharin ether, 53 5 (cor)
88	3,3-Dimethylcyclohexanol	185754	11 2	1 460615	0 91284			83				Acetate, b p 194-5 <sup>750</sup> , o- Nitrobenzoate, 62
89	cis-3,5-Dimethylcyclo- hexanol	187		1 45421	0 910921							Acetate, b p
90	trans-3,5-Dimethyl- cyclohexanol	d,l 187		1 4579	d 0 9146, l 0 9166							Acetate, $d$ , $l$ , b p , 196 $d$ , $[\alpha]_D^{26}$ +4 55, $l$ , $[\alpha]_D^{17}$ -7 74
91	d,l-1,2-Propanediol (α- Propylene glycol)	187 4		1 4316225	1 035423	bis 153, 143-4	:					Monostearate, 59 5, Distearate, 72 3
92	3,4-Dimethylcyclohexanol	189		1 45816	0 907316	119						.23
	2,4,5-Trimethylcyclo- hexanol	cis 191-3, trans 196			,	cis 83 5, al , trans 95, al	,				81-3 5, eth - lgr	
94	1,3,3-Trimethylcyclo- hexen-6-ol	193 (cor)			0 9310¦³	, , <b>u</b> i						Acetate, b p 206 7
<b>9</b> 5	2,3,6-Trimethylcyclo- hexanol	193-5747			0 9119‡7	-						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point, °C	n <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl- urethane	1 Naph thyl urethane	4 Nitro benzoate	3 5- Dinitro benzoate	Hydrogen 3-nitro phthalate	Hydro- gen phthalate	Miscellaneous
96	2-(2-Methoxyethoxy)- ethanol (Diethylene glycol monomethyl ether)	194		1 4244	1 03520			92		91 4 2 2 (anh ), 87 90 (mono- hyd ) w -al		4-Nitrophenyl- urethane, 73 5 76
97	5-Nonanol	194743		1 428918							45	Allophanate, 158
98 99	alcohol)	195 196 198	-16, -167	1 4274 <sup>25</sup>	0 8249	74 72	67	12	61 2	(cor)	22	Pseudosaccharin ether 46 (cor) Odor of pinacol, Heating with 2% HBr diene, bp 75 5-76 0
100	2-(2-Ethoxyethoxy)- ethanol (Diethylene glycol monoethyl ether)	196763		1 4298	1 02320			oil	oıl	oıl		4 Nitrophenylurethane, 65 8
101	Glycol (1,2-Ethanediol)	197 85	-126	1 43192	1 11361	dı 157	dı 176	140, 141	dı 169			bis-4-Nitro- phenylurethane,
102	d I-2-Nonanol	198 2		1 429025	0 8191045		55 5, It pet		42 8 (cor)		42 4, d,l 58-9	1333
103	I-Linalool (I-Linalyl alcohol)	199		1 46238	0 8622	65 6	53	70				$[\alpha]_{D} = 3 \text{ to } -17$
104	Benzyl alcohoł	205 5	-15 3	1 53955	1 04540	77 75 5 76, pet	134	85	113	176	106, 104	Pseudosaccharin ether, 130 (cor)
105	d,l-1,3-Butanediol (d l-1,3-Butylene glycol	207 5, 204		l 44252 <sup>19 5</sup>	1 0053	eth 122-3 d 115-6	184					Diphenyl- urethane / 127 8
106	d l-2-Decanol (Methyl n-octyl carbinol)	211		d 1 4344	d 0 8250		69, lt pet				48 9, d 38 9	
107	1-Nonanol (n-Nonyl alcohol)	213 5		1 43105	0 8271	60, 69, 62-4	65 5	60, 66	52 2	125	42 5	Pseudosaccharin ether, 49 (cor )
	1,3-Propanediol (Tri- methylene glycol)	214 7, 210-2	-30	1 43983	1 0538	di 137	dı 164	dı 119	dı 178	(cor)		Dibenzoate, 57,
109	3-Methylbenzyl alcohol (3-Tolyl carbinol)	217			0 915717		116					
1.0	<ul> <li>α 4-Dimethylbenzyl</li> <li>alcohol (α-Methyl-</li> <li>4-tolyl carbinol)</li> </ul>	219			0 966845 5	96, pet eth				i	,	
111	1-Phenyl-n-propyl alcohol (d l-Phenylethyl	219		1 5257	1 005620		102	59-60, 56 5				
112	carbinol)  2,3-Dibromo-1-propanol	219d				84		7 8 59-60				3,5-Dinitro- phenylurethane,
113	2-Phenethyl alcohol (2- Phenylethanol)	219 8	-25 8	1 5240	1 023545	78, 79- 80, al	119	61 5-2 (cor), 62-3, al	108	123	188-9	71
114	d,l-α-Terpineol	221	35, <i>d</i> , <i>l</i> 37-8	1 4834	0 9337	112 3, me al, d,l 110	152, 147	139, me al	78-9, lgr		117-8, ac a	Commercial liquid, lilac-like odor

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point °C	n (i)	D¦'	Phenvl urethane	l Naph thyl urethane	4 Nitro henzoate	3.5 Dinitro benzoate	Hvdrogen 3 nitro phthalate	Hydro gen phthalate	Miscellaneous
115	Citronellol	222 118 <sup>17</sup>										Oxid → Adipic acid, 89, Rose- like odor
116	α-Isopropylbenzyl alcohol (d,l-Isopropyl phenyl carbinol)	222 4		1 5193218	0 979020		116 7					Oxid → Iso- propylphenyl ketone, b p 222
117	d l-2-Undecanol (d l-2- Hendecanol Methyl n- nonyl carbinol)	228-9			0 826318						49 50	
118	2-(2-n-Butoxyethoxy)- ethanol (Diethylene glycol mono-n-butyl ether)	228-30		1 4341	0 957 20					:		4-Nitrophenyl- urethane 54 5- 5 3
119	1,4-Butanediol (Tetra- methylene glycol)	230, 235	190 5	1 4467	1 0171	di 183 3 5 chl 180	di 199, xyl	di 175 ac a				Dibenzoate, 81 2, eth
120 121	Geraniol 1-Decanol (n-Decyl alcohol)	230 231	5 99, 6 4	1 4766 1 43682	0 8894 0 8292	59 6, bz, then	47 8 73	35 30 2, al	62 3 57 7	117 122 8 (cor)	47, lgr 38 (cor )	Pseudosaccharin ether, 47 5 (cor )
122	<b>2-Phenoxyethanol</b> (Ethylene glycol monophenylether)	237, 245		1 534	1 10222	ai	1			112 3		Benzoate 64 4-Toluene- sulfonate 80, al
123	3-Phenylpropanol (Hydrocinnamyl alcohol)	237 4, 235		1 53565	1 0079	45 47-8, al		45 6,47	92	117		4 Nitrophenyl urethane 104 pet eth
124	1,5-Pentanediol (Penta- methylene glycol)	238-9		1 4499	0 993920	di 174-5 (cor) abs al	dı 147	<i>dı</i> 104–5, bz -al				, F
125	1-Undecanol (1-Hendecanol n-Undecylalcohol)	243	15 85, 14 3			62, al , 52		99 5, al	55	123 3 (cor)	43 8 4 1	Allophanate 156 Pseudosaccharin ether 58 5 (cor)
126	Diethylene glycol $(\beta, \beta'$ -Dihydroxydiethyl ether)	244 5	f p -10 45	1 4475	1 1212 5		149	151 (cor), 149, ac a				
127	2-Methoxybenzyl alcohol (Saligenin-2-methyl ether)	247		1 54917	1 049515		135-6					Allophanate, 180. Benzoate, 59, Igr
128	2-Benzyloxyethanol (Ethylene glycol mono- benzyl ether)	265 0		1 5225	1 070020							Triphenylmethyl ether, 76 7, eth
129 130	n-Hexyl phenyl carbinol Triethylene glycol (Ethylene glycol di-(β-hydroxyethyl)ether)	275 285, 165 <sup>14</sup>	-94	1 501 1 4578 <sup>15</sup>	0 946 1 1274 <sup>15</sup>	75						bis-Triphenyl- methyl ether, 142 2 5, acet
131		290d	179	1 4729	1 26134	tri 180	tri 191- 2, al	tri 188				4-Nitrophenyl urethane, 216 Tribenzoate,
132	3,4-Dimethoxybenzyl alcohol (Veratryl alcohol)	296-7 <sup>732</sup>		1 55517	1 179 17	118						71 2, 75 6 Acetate, b p 170 <sup>12</sup> , n <sub>b</sub> <sup>7</sup> 1 5245, Ben- 20ate, 36 7

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point °C	n 20 D	D <sub>4</sub> º	Phenyl urethane	1 Naph thyl urethane	4 Nitro benzoate	Dinitro	Hydrogen 3 nitro phthalatc	gen	Miscellaneous
133	carbinol (4 Anisyl methyl carbinol)  cis-Octa-9-decen-1-ol (Oleyl alcohol cis-	310d (cor)		1 557	1 086 <sup>16</sup>	82 3 oil	β 44 5 al					Odor of anise Oxid -+ 4 Methoxy acetophenone 38 Allphanate 135 chl 129 chl
	Octadecenyl alcohol)											4 Nitrophenyl urethane 85 91

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS b) Solids (Listed in order of increasing m.p.)\*

<del></del>										<del>,</del>
Name	Melting point °C	Boiling point, *C	Phenyl urethane	l Naph thyl urethane	4 Nitro benzoate	3,5 Di nitro benzoate	Hydro gen 3 nitro phthal ate	Hydrogen phthalate	Pseudo sac charine ether	Miscellaneous
1	20, 20 1	202		106	43 (cor ),	95 93		108		ng 1 5275,
phenyl carbinol)	1	1	igr		ai	[	[	ac a	[	D <sub>4</sub> ° 1 0129
	ł				l				l	Oxalate d l 61
,	24, 26	239	<sup>/4</sup>	80	45, 42	00		1		
1,1-Dimethyl-2-phenylethanol	24	216					(cor)	(cor)	(cor)	п <sub>В</sub> 1 5174
1	24–5	259	92 (cor )							Benzoate, 38, Me eth, bp 225-6, n <sup>25</sup> 1 5422, D <sup>15</sup> 1 1129
Cyclohexanol	25 1	161 1	82	129	50	112 3, al	160	99		n <sub>D</sub> 1 46477 D <sub>2</sub> 0 94155
tert-Butyl alcohol (Trimethyl carbinol)	25 5	82 5	136, eth	101	116, al	142, pet eth				n <sub>D</sub> <sup>20</sup> 1 38779, D <sub>4</sub> <sup>20</sup> 0 78670
3-Nitrobenzył alcohol	27	175–80³								Benzoate, 71 2 Ox → 3-nitro benzoic acid 140
Diethanolamine ( $\beta$ , $\beta'$ -Dihydroxy-	28 28	197 270, 217-								Picrate, 109-10
	30 5_1 5	-	78_9			25				
· ·	α 30 6,	155 615	,,,,		37 4 (cor.)	05	124 (cor.)	52 5	66 (cor.)	D <sub>4</sub> <sup>31</sup> 0 8223
Cinnamyl alcohol		257	90 0-1 5	114	' '	121	(451 )		(4-1 /	
	36, 35	219	79 (cor )		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
trans-Octa-9-decen-1-ol (Elaidyl alcohol)	36 7, 35, 34	333, 216 <sup>18</sup>	56–7	71						
d,l-Fenchyl alcohol	38-9, d α 45, l α 47, l β 3-4	201 5, d α 201-2	104, d α 82, l α 82	149	109, α 108 9 β 94-5, I α 109, I β 83	104	95	169, d α 145, l α 146, l β 153		
1-Tetradecanol (Myristyl alcohol)	39, 37 7	170-320	74, 71	82	51 2 (cor)	67	123 5 (cor)	60 (cor )	62 (cor)	
1,2,2-Trimethylcyclohexanol	41 (+½ H <sub>2</sub> O)	81 4-820								п <sup>18.4</sup> 1 469, D <sup>18.4</sup> 0 9274
Pinacol (Tetramethylethylene glycol)	43, 45-6	172								Diacetate, 65, Hydrate, 46
	44, 42 5, 35, 33, 31, d 38-40	216	111-2, al, dl 103-4	119, 126	61-2	153		112, 129- 31, ac a		Allophanate, 215
1-Pentadecanol	α 44,β		72, bz	72	45 8 (cor.)		122 5 (cor.)	60 4	72 (cor.)	
1,3,5-Trimethyl-1-cyclohexen-3-ol	46	87-9017			(001)		(001)		(501)	п <sup>19</sup> з 1 4735, D <sup>20 2</sup> 0 9132
$d$ , $l$ - $\alpha$ -Propyibenzyl alcohol	d 49, 1 49	168-70100		99	58			91, 53–4		7132
1,1,1-Trichloroisopropanol	50-1	161 8773								Camphor-like odor
	50, 49 27	19018	73	82	58 4	66	122	66.8	69 5	
•	,			_	(cor ),	-	(cor)		(cor)	
2,2,6-Trimethylcyclohexanol	51, al	186-7753			32				:	n <sub>D</sub> <sup>20</sup> 1 4600, D <sub>4</sub> <sup>20</sup> 0 9128
	1-Phenylethyl alcohol (d l Methyl phenyl carbinol) trans-2-Methylcyclohexanol 1-Dodecanol (n-Dodecyl alcohol, Lauryl alcohol) 1,1-Dimethyl-2-phenylethanol (Benzyl dimethyl carbinol) 4-Methoxybenzyl alcohol (4 Anisyl carbinol)  Cyclohexanol tert-Butyl alcohol (Trimethyl carbinol) 3-Nitrobenzyl alcohol  2,3,3-Trimethylcyclohexanol Diethanolamine (β,β'-Dihydroxydiethylamine) 2,4-Hexadien-1-ol 3-Tridecanol  Cinnamyl alcohol 2-Methylbenzyl alcohol (2 Tolyl carbinol) trans-Octa-9-decen-1-ol (Elaidyl alcohol) d,l-Fenchyl alcohol	1-Phenylethyl alcohol (d l Methyl phenyl carbinol)   trans-2-Methylcyclohexanol   1-Dodecanol (n-Dodecyl alcohol, Lauryl alcohol)   1,1-Dimethyl-2-phenylethanol (Benzyl dimethyl carbinol)   4-Methoxybenzyl alcohol (4 Anisyl carbinol)   24   24-5	1-Phenylethyl alcohol (d I Methyl phenyl carbinol)   1/20, 20 1   167 4   24, 26   259	1-Phenylethyl alcohol (d l Methyl phenyl carbinol)   20,201   202   167 4   d l 105   1	Name   Point C   Point C   Point C   Point C   Printy   Path   Printy   Point C   Po	1Phenylethyl alcohol (d l Methyl phenyl carbinol)   20, 20 1   202   92, 91-2,   106   43 (cor ),   al   174   174   175   47   175   180	Name   Point *C   P	Name   Melting point, C   Poonts, C   Prenty clarbano   Individe the point, C   Prenty clarbano   P	Name	Name

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	i Naph thyl urethane	4 Nitro benzoate	3 5 Di nitro benzoate	Hydro gen 3 nitro phthal ate	Hydrogen- phthalate	Pseudo sac charine ether	Miscellaneous
27	3,3,5-Trimethylcyclohexanol	trans 52,	cis 201- 3 <sup>750</sup> , trans					-			Acetate, cis b p 209-10, trans b p 209-10
28	2,2-Dimethyl-1-propanol (tert- Butyl carbinol, Neopentyl alcohol)	52-3	196 5 <sup>770</sup> 113	144, Igr	100				71		
29	4-Methylbenzhydrol (Phenyl 4-tolyl carbinol)	53, 58, 42									Ox → Phenyl 4-tolyl ketone, 60
30		α 54	310		88 5	53 8 (cor )	121 5 (cor)	121 0- 8	66 6- 7 (cor)	76 (cor)	
31	Piperonyl alcohol	58		102 5		,	. ,		, ,	` '	Benzoate, 66, Allo phanate, 176 5
32	4-Methylbenzyl alcohol (4-Tolyl carbinol)	59-60	217	79			117 8				
33	, , , , , , , , , , , , , , , , , , ,	59 5	210 515	79–80		64 3 (cor)	66	119 (cor)	72 5 (cor)	74 5 (cor)	
34	1-Nonadecanol	62				58 9			71	80 5	
35	Eicosanol	65	220³			69 4			77		Acetate, 40
36	1-(1-Naphthyl) ethanol (d,l- Methyl i-naphthyl carbinol)	66							131-2, bz		
37	1,2-Diphenylethanol (d l-Benzyl phenyl carbinol)	67	16710						(cor), eth-lt pet		
38	4,4'-Dimethylbenzhydrol (D1-4-tolyl carbinol)	68, al							, p. c		Carbinyl bromide 48 5-9 lgr
39	Benzhydrol (Diphenyl carbinol)	68, lgr	288, 180 <sup>20</sup>	139 40, bz	135 6, 139	131-2	141		164 5		Acetate 41 2 Benzoate 88-9, al
40	1-Glyceryl phenyl ether	69, eth									Conc H₂SO₄ → pa red
41	Erythritol (d,l-1,2,3,4 Tetra- hydroxybutane)	72									Tetraacetate, 53
42	Dihydroxyacetone (1,3-Di- hydroxy-2-propanone)	72									Diacetate, 48, Di- benzoate, 120 5, 2,4-Dinitrophenyl- hydrazone, 277-8
43 44	2-Nitrobenzyl alcohol 1,10-Decamediol (Decamethylene glycol)	74 75 5, 72	270 16520								Benzoate, 101-2 1 10-Dibromide, 27 4 bp 162 5 510
45	2,2,2-Tribromoethanol	80	92-310								Urethane, 86-7
46	10-Nonadecanol (Myricyl alcohol)	85		96	54					]	
47	Phenacyl alcohol (α-Hydroxy- acetophenone, Benzoyl carbinol)	86	118-2011		:	128 6					Benzoate, 118 5, 3-Nitrobenzoate, 104 5
48	n-Triacontanol (1-Hydroxytria- contane)	86 5, bz									Acetate, 69, pet eth
49	2-Hydroxybenzyl alcohol (Saligenin)	86–7									2-Benzoate, 66
50	d-Sorbitol	89-93, 112 (anh )									Hexaacetate, 99, Hexabenzoate, 216-7, et ac
51	3-Nitrophenacyl alcohol (3-Nitrobenzoyl carbinol)	92 5-30, pa yel									Acetate, 53, eth - lgr, Semicarba- zone, 214, al

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl- urethane	l Naph thyl urethane	4-Nitro benzoate	3,5-Di nitro- benzoate	Hydro gen 3-nitro phthal ate	Hydrogen- phthalate	Pseudo sac charine ether	Miscellaneous
52	4-Nitrobenzyl alcohol	93	18512							-	Acetate, 78, Ben-
53	<b>4.4.4"-Trimethyltriphenyl car- binol</b> (Tris- <i>p</i> -tolyl carbinol)	96				3					zoate, 94 5 Et eth 111 pet eth H <sub>2</sub> SO <sub>4</sub> → gr -
54	meso-Erythritol	121, 120 (cor)	330								Tetraacetate 85 89 Dibenzylidene, 201-2
55	4-Nitrophenacyl alcohol (4-Nitrobenzoyl carbinol)	121									Acetate, 124, et ac -lgr, Phenyl- hydrazone, 178, bz
56	d l-Benzoin (Benzoyl phenyl carbinol)	137, 133	344	165	140	123					4 Nitrophenyl- urethane 183 Acetate, 83
57	Cinchol (β-Sitosterol)	137					202 4				Acetate, 134, Benzoate, 145
58	Furoin (Furoyl furyl carbinol)	138 9 (cor ), 135									Acetate, 76-7 Benzoate, 92-3
59	Cholesterol (anh ) (1-Cholesterol)	148 5	360d	168	176	185 190 3			161		4-Nitrophenyl- urethane, 205 Benzoate, 151-2
60	Triphenylmethanol (Triphenyl carbinol)	161 2, bz	380								Acetate, 87 8
61	Ergosterol	165		185	202		202, chl				Acetate, 176, 180, eth , Benzoate, 168
62	d-Mannitol	166, <i>l</i> 163–4, <i>d l-α</i> 168		303							Hexaacetate, 126, eth , Benzoate, 149-50, 147-8, al
63	1,1,1-Tribromo-tert-butyl alcohol (Brometone)	167-76, w -al									Acetate, 43 4, al , Benzoate, 27, al
64	Dulcitol (1,2,3,4,5,6-Hexanehexol)										Hexaacetate, 171, 168 9, abs al, Hexabenzoate, 189-91, eth -chl
65	4,4',4''-Triammotriphenyl carbinol (Pararosaniline base)	205									4 4 ,4" Triacetyl, 192 acet -eth Me eth 105, eth, 135, bz
66	d-Borneol ("Borneo camphor")	208, 205, d l 210 5	212	138-9	132, <i>iso</i> 130, 127	153, <i>d I</i> 134, 137	154 5		161 4, ac a , 165 (cor)	i	
67	meso-Inositol (1,2,3,4,5,6-Hexa- hydroxycyclohexane)	225 (cor ), 218			* #- "		86, al		(60, )		Hexaacetate, 212, subl, tol, Hexa- benzoate, 258, al
68	d-Quercitol (Pentahydrocyclo- hexane)	232, 234								Ì	Pentabenzoate, 155
69		262 253									Tetraacetate, 84, wh, al, Tetra- benzoate, 99-101, al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLE VII

Phenylurethane

ArOH + 
$$C_6H_5N=C=O \rightarrow C_6H_5NHCOOAr$$

Phenylurethane (Phenylcarbamate)

From the phenol with phenylisocyanate without solvent

For directions and examples see Linstead, pp 34-35, J B McKinley, J E Nickels and S S Sidue, Ind Eng Chem, Anal Ed., 16, 304 (1944)

From the phenol with phenylisocyanate in kerosene

See Cheronis, p 489

From the phenol with phenylisocyanate and a catalytic amount of pyridine

See Shriner, p 265

From the phenol with phenylisocyanate in toluene

See O L Brady and J Harris, J Chem Soc, 127, 2175 (1925)

1-Naphthylurethane ( $\alpha$ -Naphthylcarbamate) \*

ArOH + 
$$1-C_{10}H_7N=C=O \rightarrow 1-C_{10}H_7NHCOOAr$$

1-Naphthylurethane (α-Naphthylcarbamate)

From the phenol with 1-naphthylisocyanate without solvent

For directions and examples see Cheronis, p 488, Linstead, pp 34-35, Vogel, p 683, Wild, p 68

From the phenol with 1-naphthylisocyanate and a catalytic amount of pyridine, triethylamine or trimethylamine in ether

See Shriner, p 211, Vogel, p 683, Wild, p 68, H E French and A F Wirtel, J Amer Chem Soc, 48, 1736 (1926)

From the phenol with 1-naphthylisocyanate and a catalytic amount of a tertiary aliphatic amine in petrol ether

See Cheronis, p 488, Vogel, p 684

p-Nitrobenzoate \*

ArOH + 
$$O_2N$$
 — COCI  $\rightarrow O_2N$  — COOAr + HCI

From the phenol with p-nitrobenzoyl chloride in pyridine For directions and examples see Vogel, p 682, Wild, p 52 From the phenol with p-nitrobenzoyl chloride without solvent See Wild, p 52

3.5-Dinitrobenzoate \*

ArOH + 
$$\frac{NO_2}{NO_2}$$
  $\frac{NO_2}{NO_2}$   $\frac{NO_2}{NO_2}$   $\frac{NO_2}{3,5-D_{\text{initrobenzoate}}}$ 

From the phenol with 3,5-dinitrobenzoyl chloride in pyridine

For directions and examples see Cheronis, p 486, Vogel, p 682, Wild, p 65, R C Brown and R E. Kremers, J Amer Pharm Ass, 11, 607 (1922), M Phillips and G L Keenan, J Amer Chem Soc, 53, 1924 (1931)

From the phenol with 3,5-dinitrobenzoyl chloride without solvent See Shriner, pp 212-213

Benzoate

ArOH + 
$$C_6H_5COCI \rightarrow C_6H_5COOAr + HCI$$

From the phenol with benzoyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 481-482, 487, Linstead, p 20, Wild, p 65

\*Derivatives recommended for first trial

### **EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)**

From the phenol with benzoyl chloride in pyridine See Linstead, p 19

Acetate

From the phenol with acetic anhydride in aqueous sodium hydroxide

For directions and examples see Linstead, p 21, Vogel, p 682, Wild, p 64, F D Chattaway, J Chem Soc, 2495 (1931)

From the phenol with acetic anhydride and sodium acetate

See Linstead, p 21, Wild, p 64

From the phenol with acetic anhydride and a catalytic amount of sulfuric acid

See Cheronis, p 487

### p-Phenylazobenzoate

ArOH + 
$$N=N-COCI \rightarrow N=N-COOAr + HCI$$

p Phenylazobenzoate

From the phenol with p-phenylazobenzoyl chloride in pyridine

For directions and examples see Cheronis, p 486, E O Woolfolk and J M Taylor, J Org Chem, 22, 827 (1957)

#### p-Toluenesulfonate

ArOH + 
$$CH_3$$
— $SO_2Cl \rightarrow CH_3$ — $SO_3Ar + HCl$ 

p-Toluenesulfonate

From the phenol with p-toluenesulfonyl chloride in pyridine

For directions and examples see Linstead, p 20, Vogel, p 684, Wild, p 66

From the phenol with p-toluenesulfonyl chloride in aqueous sodium hydroxide

See Linstead, p 20

From the phenol with p-toluenesulfonyl chloride and sodium hydroxide in aqueous acetone

See Wild, p 66

#### Bromo derivative \*

From the phenol in aqueous methanol, in ethanol, in acetone or in dioxane with bromine in aqueous potassium bromide

For directions and examples see Cheronis, p 490, Shriner, p 264

From the phenol in aqueous hydrochloric acid with bromine in water

See Linstead, p 19

From the phenol in glacial acetic acid and bromine

See Wild, p 73

From the phenol with bromine in carbon disulfide

See Vogel, p 679

For a discussion on the effect of solvents in the bromination of phenols

See N D Cheronis, Micro and Semimicro Methods (Technique of Organic Chemistry), Vol 6, Interscience, New York, 1954, pp 286-287

#### \*Derivatives recommended for first trial

### **EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)**

Aryloxyacetic acid.\*

From the phenol in aqueous sodium hydroxide with aqueous chloroacetic acid.

For directions and examples see: Cheronis, pp. 489-490; Linstead, p. 20; Shriner, p. 264; Vogel, p. 683; Wild, p. 72; C. F. Koelsch, J. Amer. Chem. Soc., 53, 304 (1931); N. V. Hayes and G. E. K. Branch, J. Amer. Chem. Soc., 65, 1555 (1943).

Aryl 2,4-dinitrophenyl ether.

ArONa + 
$$O_2N$$
  $\longrightarrow$   $O_1$   $\longrightarrow$   $O_2N$   $\longrightarrow$   $O_$ 

From the phenol in aqueous sodium hydroxide with 2,4-dinitrochlorobenzene in alcohol.

For directions and examples see: Cheronis, pp. 490-491; Vogel, p. 684; Wild, p. 71; R. W. Bost and F. Nicholson, J. Amer. Chem. Soc., 57, 2368 (1935).

From the phenol with 2,4-dinitrochlorobenzene and aqueous potassium hydroxide.

See: Linstead, pp. 20-21.

NOTE: For additional information regarding directions and examples for the preparation of derivatives of phenols which are similar to those of alcohols (e.g., 1-naphthylurethanes, 3,5-dinitrobenzoates, etc.) see explanations and references to Table VI, p. 77, 78, 79.

<sup>\*</sup>Derivatives recommended for first trial.

No	Name	Boiling point °C	Melting point, °C	n 20	D20	Phenyl- urethane	α-Naph- thyl- urethane	p-Nitro- benzoate	3 5-Di- nitro- benzoate	Bromo derivative	p- Toluene sulfonate	Miscellaneous
1	2-Chlorophenol	175 6	7	1 547340	1 2410	121	120	115	143	mono 48 9, di 76	74	Aryloxyacetic acid, 145, 2,4-Dinitro- phenyl ether, 99, 4,6- Bis(dimethylamino- methyl) deriv, 62 3, p-Phenylazo- benzoate, 120-1
2	2-Bromophenol	195	5		1 4924		129			95	78	p-Phenylazobenzoate,
3	<b>2-Chloro-4-methylphenol</b> (2-Chloro- <i>p</i> -cresol)	195 6		1 52002	1 178527			i				Benzoate, 71 2, Aryloxyacetic acid, 108, Acetate, b p 238
4	2-Hydroxybenzaldehyde (Salicylaldehyde)	197 (cor)	16	1 574	1 169020	133		128			63 4	Aryloxyacetic acid, 132, Acetate, 39
5	3-Methylphenol (m-Cresol)	203	12	1 540	1 03401	125, 121 2, al -lgr	127 8	90	165 4 (cor), al	tri 84	51	Aryloxyacetic acid, 103, 2,4-Dinitro- phenyl ether, 74, Benzoate, 55
6	2-Ethylphenol	207			1 0371"	143 4, 141		56 7	108		!	Aryloxyacetic acid, 141, Benzoate, 38-9, al
7	2-Isopropyiphenol	212	16	1 5315	1 012							Aryloxyacetic acid, 132 3, Methyl urethane, 96 7, 4,6- Dinitro deriv, 53
8 9	2-Bromo-4-ethylphenol 3-Ethylphenol	213 4 217	-4		1 0250°	137, 138 8		68			121	Aryloxyacetic acid, 77, Benzoate, 52, 95% al
10	2-Allylphenol	220	-6	1 5181	1 0255 \$	116, 106 0 6 5				6- <i>mono</i> 50		Aryloxyacetic acid, 148 5-50
11 12	2-Chloro-4,6-dimethylphenol Methyl salicylate (Methyl 2- hydroxybenzoate)	221 3 224	-8	1 5369	1 184	129 30 117, bz		94-5 128				Acetate, 52, Benzoate, 92, al
13	2-Propylphenol	224 6- 6 6, 220 0- 0 5		1 5280	1 000 15	formic a			96			Aryloxyacetic acid, 99-100
14	2-sec-Butylphenol	227-8, 116 <sup>21</sup>	12-3	1 5288	0 9876	86, lgr						Aryloxyacetic acid, 109 5-110
15	4-Allylphenol	230-1750	16	1 544118	1 03318			ı	103 0- 3 5			Urethane, 122 3, Acetate, b p 238-9
16	Ethyl salicylate (Ethyl 2-hydroxybenzoate)	234	13	1 5226	1 131	98 100		107-8, yel, bz				Benzoate, 79-80, 87, al , 3,5-Dinitro deriv , 92-3
17	2-n-Butylphenol	234-7 113 514		1 518025 5	0 975				97			Aryloxyacetic acid, 104-5, Acetate, 105 5
18	4-Isobutylphenol	236, 235-9		1 531925	0 9796⅔							Aryloxyacetic acid, 124-5
19	Carvacrol (5-Isopropyl-2- methylphenol)	237 8	1	1 524	0 9760	134 5, 138	116, lgr	51	83, 76-7	46		Aryloxyacetic acid, 151, p-Xenylure- thane, 116, al
20	Isopropyl salicylate (Iso- propyl 2-hydroxybenzoate)	240-2		1 50650	1 0729							3,5-Dinitro deriv,

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

	·					<del>,</del>		,				
No	Name	Boiling point, °C	Melting point, °C	n 20 D	D <sup>20</sup>	Phenyl- urethane	α-Naph- thyl- urethane	p-Nitro- benzoate	3,5-Di- nitro- benzoate	Bromo derivative	<i>p</i> - Toluene sulfonate	Miscellaneous
21	3-Methoxyphenol (Resorcinol monomethyl ether)		-175				128 9			tri 104		Aryloxyacetic acid, 118, 111-3, w , 2,4- Dinitrophenyl ether, 87-8
22	2-Allyl-6-methoxyphenol	250-1 115°		1 5393				96 7				
23	4-Allyl-2-methoxyphenol (Eugenol)	254 8, 127 <sup>15</sup>	-91, 169	1 5410	1 0664	95 5	122, lgr	81	130 8 (cor), al	<i>1etra</i> 118	85	Acetate, 29, al , Benzoate, 70, al , Aryloxyacetic acid, 81 100, 2,4-Dinitrophenyl ether, 115, N,N-Diphenylurethane, 108
24	Isobutyl salicylate (Isobutyl 2-hydroxybenzoate)	260 2		1 50872	1 0639							3,5-Dinitro deriv , 72 3, al
25	d./-1,2,3,4-Tetrahydro-2- naphthol	264716		1 552317	1 071517	99			i i			Acetate, bp 169 <sup>34</sup> , Benzoate, bp 254 5 <sup>40</sup>
26	2-Methoxy-4-propenylphenol (Isoeugenol)	267 5		cis 1 5700, trans 1 5782	cis 1 0851, trans 1 0852	trans 152	149 50, lgr	109	154 8 (cor), n- BuOH			Acetate, 79-80, bz - lgr, Benzoate, cis, 68, irans, 103, 4, al Aryloxyacetic acid, 116 (94), 2,4-Di- nitrophenyl ether, 128
27	n-Butyl salicylate (n-Butyl 2- hydroxybenzoate)	270-2, 259-60	-59	1 51148	1 0728							3,5-Dinitro deriv, 60 1, al, p-Nitro- benzyl ether, 92
28	Isoamyi salicylate (Isopentyl salicylate)	276 8		1 50799	1 0535							3,5-Dinitro deriv, 61-2, al
29		283		1 5328								Saponification → resorcinol, 110 + ac a , Diacetate, b p 130 17

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

# TABLE VII. ORGANIC DERIVATIVES OF PHENOLS b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point °C	Phenyl ure-	α-Naph- thyl- ure-	p-Nitro ben-	3,5-Di- nitro-	Bromo derivative	p- Toluene sul-	Acetate	Benzoate	Miscellaneous
	2 Boggylphoret /2 11:		ļ	thane	thane	zoate	benzoate		fonate			M. at 20 II
1	2-Benzylphenol (2-Hy- droxydiphenylmethane) (Labile form)	21, stable 52,54	312	117-8								Me eth, 30, Ure- thane, 110-1
2	4-n-Propylphenol	22	232	129			123			b p 245 6 <sup>745</sup>	38	n <sub>D</sub> 1 5220
3	4-n-Butylphenol	22	248, 138-9 <sup>18</sup>	115, al		67-8, yel al	92			b p 138- 4115	27	n <sup>25 5</sup> 1 5165, D <sup>20</sup> 0 978, Aryloxy- acetic acid, 81
4	4-n-Amylphenol (4-n- Pentylphenol)	23	248-53								51 0 9 5, al	n <sub>D</sub> <sup>2</sup> 1 5272, D <sub>20</sub> <sup>20</sup> 0 9621, Aryloxy- acetic acid, 90
5	3-n-Propylphenol	26	228				75 (117- 8)					n <sub>B</sub> <sup>20</sup> 1 5223, D <sub>4</sub> <sup>20</sup> 0 9887, Aryloxy- acetic acid, 96-7, lgr
6	2-Chloro-3,4-dimethyl- phenol	27, pet eth						-			87, aq al	
7	2,4-Dichloro-3-methyl- phenol (2,4-Dichloro-m- cresol)	27	240 5- 2 5						92 0 2 5, al		90 5	Benzenesulfonate, 70, al
8	2,4-Dimethylphenol (m-4-Xylenol)	27 8	211 5 (cor)	103, 112, CCl <sub>4</sub>	135	102, 105	164 6 (cor), 95% al				37 8, ac a	nis 1 5420, Di <sup>4</sup> 1 0276, p-Xenyl- urethane, 184, Aryloxyacetic acid, 141, p-Phenylazo- benzoate, 110-3 2 4-Dinitrophenyl
9 10	2-Ethoxyphenol 2-Acetylphenol (2-Hydroxyacetophenone)	28 28	217 215							89, al	31 87 8, al	ether, 102-3 Allophanate, 212 n <sup>20</sup> 1 5590, D <sup>20</sup> 1 131, Semicarbazone, 210, Oxime, 118, Phenylhydrazone, 110
11	2-Methylphenol (o-Cresol)	31	191-2	141, 143	141 2, lgr	94	138 4 (cor), al	dı 56	54 5, pyr			Aryloxyacetic acid, 152, p-Phenylazo- benzoate, 110– 11 5, 2,4-Dinitro- phenyl ether, 90, N,N-Diphenylure- thane, 73
12	2-Methoxyphenol (Guatacol)	32, 28 2	205	136, al	118	93	141 2 (cor ), al	4,5,6- tri 116, al	85, lgr		57 8	n % 1 5441, D <sup>20</sup> 4, 1 1287, Aryloxy-acetic acid, 116, 2,4-Dinitrophenyl ether, 97
	5-Fluoro-2-nitrophenol 3-Bromophenol	32, lgr 33	236		108				52 4	b р 149 <sup>40</sup>	110 11 86	Me eth, 52, lgr Aryloxyacetic acid, 108, p-Phenylazo-
15	3-Chlorophenol	33	214		158	99	156				71	benzoate, 125-6 Aryloxyacetic acid, 110, 2,4-Dinitro- phenyl ether, 75, p-Phenylazoben-
16	2-Bromo-4-chlorophenol	33–4	12310								99-100	zoate, 127-8 Aryloxyacetic acid, 139-40

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE VII. ORGANIC DERIVATIVES OF PHENOLS b) Solids (Listed in order of increasing m.p.)\* (Continued)

	<del></del>									·		
<b>N</b> o	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thvl- ure- thane	p-Nitro- ben zoate	3,5-Di nitro- benzoate	Bromo derivative	p- Toluene sul fonate	Acetate	Benzoate	Miscellaneous
17	4-Methylphenol (ρ-Cresol)	36	202	115	146	98	188 6 (cor), al	di 49, tetra 198-9, al	69-70, al		70	p-Phenylazoben- zoate, 134 5-6 5, N,N-Diphenylure- thane, 94, p-Xenyl- urethane, 198
18	2,4-Dibromophenol	36, 40	238-9			183 5		6-mono 95-6	120	36	97 5	Aryloxyacetic acid, 153, 2,4-Dinitro- phenyl ether, 135, Me eth, 61 3, b p
19	4-Methyl-2-nitrophenol (2-Nitro-p-cresol)	36 5, yel , w -al	12522				192				100-1	272, Et eth, 53 5 Me eth, 8 5, pa yel, bp 274, Et eth, bp 275 85 d
20	4-Chlorophenol	37, 43	217	148 5	166	171	186	2-mono 33 4, 2,6-di 90	71	7 8	88	Afyloxyacetic acid, 156, 2,4-Dinitro- phenyl ether, 126, p-Phenylazoben- zoate, 153-4, N, N-Diphenylure- thane, 97
21	2,4-Diethylphenol	37-8	219	170 1								Aryloxyacetic acid,
22 23	3-Fluoro-2-nitrophenol 2,6-Dichloro-4-methyl- phenol (2,6-Dichloro-p- cresol)	39, lgr 39, 42	120-514							48	114 9	67-8 Me eth , 43 5, lgr NH <sub>4</sub> salt, 125, Me eth , b p 234
24	,	40	246-7, pa yel, 254-8			183 5					97 5	2,4-Dinitrophenyl ether, 114-5, Picrate, 105-6, red, chi
25	3-Iodophenol	40		138		133	183		60-1	38, pet eth	72-3, pet eth	Aryloxyacetic acid,
26	2-Benzoylphenol (2- Hydroxybenzophenone)	41				124						p-Nitrobenzyl ether, 124 5, acet , Phenylhydrazone, 155, Semicarba- zone, 250-1, Oxime, 141 3
27	3-Methyl-2-nitrophenol	41, yel, pet							ĺ	59, al	79, al	Me eth, 54, yel, al
28	(2-Nitro-m-cresol) Phenol	eth 41 8, 42	182, 183	126, bz	132 3, lgr	127, bz	145 8 (cor), al	tri 95	95 6, al		69	Aryloxybenzoic acid, 99, p-Phenyl- nzobenzoate, 148– 50, p-Xenylure- thane, 173, N,N- Diphenylurethane, 105
29	3-Fluoro-4-nitrophenol	42, w or	17312								118	Me eth , 56 5
30	Phenyl salicylate (Salol, Phenyl 2-hydroxy- benzoate)	lgr 42, 38 8, 28 5 (three forms)		111-2, bz, 242		111				99 5	81	N,N-Diphenyl- urethane, 144

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

# TABLE VII. ORGANIC DERIVATIVES OF PHENOLS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl ure thane	α-Naph- thyl- ure thane	p-Nitro- ben zoate	3,5-Di- nitro- benzoate	Bromo derivative	p- Toluene sul- fonate	Aceta e	Benzoate	<b>M</b> iscellaneous
31	2-lodophenol	43	186-7160	122						98 101	34, pet eth	D <sup>xii</sup> 1 8757 Aryloxyacetic acid, 135 p- Phenylazoben- zoate 126 8 2,4 Dinitrophenyl ether, 95
32	5-Bromo-2-nitrophenol	44 yel					1		!	74 5		Me eth, 85 5 Et eth, 79 5 80 5, al
33	2,4-Dichlorophenol	45	210				142~3	68	125		97	Aryloxyacetic acid, 141, 135, β-Naph-thylurethane, 166, 2,4-Dinitrophenyl ether, 119
34	2-Nitrophenol	45, yel, al	216		113	141	155	di 117	83	40 1, Igr	59	D <sub>4</sub> <sup>10</sup> 1 2942, Aryloxyacetic acid, 158, 2,4-Dini- trophenyl ether, 142, N,N-Di- phenylurethane, 114, p-Phenylazo- benzoate, 136 5
35	5-Chloro-2-hydroxy- biphenyl	46									88	, 0
36	2-Chloro-5-methylphenol	46	196						96	bр	31 40	Benzenesulfonate,
37	(6-Chloro-m-cresol) 4-Bromo-5-isopropyl-2- methylphenol	46, lgr				53 4				122-311		99 Me eth, bp 147 50 <sup>15</sup>
38	2-tert-Butyl-5-methyl- phenol (6-tert-Butyl-m- cresol)	46-7	12711							b p 139 <sup>17</sup>		Me eth, 22, b p 225 7
39	3-Chlorocatechol (3- Chloro-1,2-dihydroxy- benzene)	46-8, 48 50	110 11"								110-11	2-Me eth , 31 5 3 0
40	<b>4-Ethylphenol</b> (4-Hydroxyethylbenzene)	47	219	120	128	80 1	132-3				59 60, al	n <sub>25</sub> 1 5239, D <sub>20</sub> 1 0123 Aryloxy- acetic acid, 97, p- Phenylazo- benzoate, 117-8
41	3-Methyl-2,4,6-trichloro- phenol (2,4,6-Trichloro- m-cresol)	47, w	265						92 3	35, 32, eth	53	56H2Oate, 117-5
42	4-Chloro-o-cresol)	48	222-5								71	Aryloxyacetic acid, 115 7, Me eth,
43	<b>2,6-Dibromo-4-methyl- phenol</b> (2,6-Dibromo- <i>p</i> - cresol)	49, 54				141 2				67	94 5	bp 213 5
44	Thymol (2-Isopropyl-5- methylphenol)	49 7, 51 5, acet	233 5	107, aq al	l60, lgr	70	103 2, al	55	71	b p 242 3	33	Aryloxyacetic acid, 149, 2,4-Dinitro- phenyl ether, 67, p-Xenylurethane, 194, p-Phenylazo- benzoate, 85 6

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	Phenyl ure- thane	α-Naph thyl- ure- thane	p-Nitro- ben- zoate	3 5-Di- nitro benzoate	Bromo derivative	p- Toluene sul fonate	Acetate	Benzoate	Miscellaneous
45	2-Hydroxy-4-methoxy- acetophenone (Peonol)	52 3, al								46 5		ng <sup>k1 2</sup> 1 54322, D <sup>k1 2</sup> 1 310, m-Nitro benzoate, 109, p- Nitrophenyl- hydrazone, 238 9, ac a
46	<b>2-Benzylphenol</b> (2- Hydroxydiphenyl- methane) (stable form)	52 54, labile 21-2	312	117 5- 8 0, lgr								Benzyleth, 38, me al
47	2-Chloro-3-methylphenol (2-Chloro-m-cresol)	55 6 49 50	194	1g1					96		55 6	Benzenesulfonate,
48	4-Methoxyphenol (Hydroquinone monomethyl ether)	56 55	243 4	i e						32	87, al	Aryloxyacetic acid, 110-2
49	3-Methyl-6-nitrophenol (6-Nitro-m-cresol)	56, yel , bz								48, al	77	Me eth, 62, Et eth, 55, pet eth, 50-1
50	3-Bromo-4-methylphenol (3-Bromo-p cresol)	56	245								75	Me eth, bp
51	2-Phenvlphenol (2 (Hydroxybiphenyl)	56, 67 5 (cor)	275						64 6, dıl al	62 5 3 pet eth	75-6	p Phenylazoben- zoate, 141 4, 2,4- Dinitrophenyl ether, 113-4
52	2,6-Dibromophenol	56-7	16221					93 3		46	68	Me eth, 13, b p 143-5 <sup>34</sup> , Et eth, 40 6
53	4-n-Caproylresorcinol	56 7, tol - pet eth	343 5 d			89 91 pa yel, al						
54	2-Bromo-4-methylphenol (2-Bromo-p-cresol)	56 7	213-4, 102 4 <sup>20</sup>						121	b р 120 <sup>3</sup>		D24 5 1 547
	5-Bromo-3-methylphenol (5-Bromo-m-cresol)	56-7, 54								83		Me eth, bp 139 40 <sup>20</sup> , Picrate, 130
56	2-Cyclohexylphenol	56 7										4,6-Dinitro deriv, 106, al, 2,4-Dini- trophenyl ether 76 7
57 58	2,3-Dichlorophenol 4,6-Dibromo-2-methyl- phenol (4,6-Dibromo-o- cresol)	56 7 57	206			136 7		dı 90			62	Me eth , 31
59	3-Hydroxy-6-nitro- biphenyl	57 8, bz				135	171					2 4-Dinitrophenyl ether, 131 4-Nitro deriv, 176-8
1	2,3,6-Trichlorophenol 2,6-Dichloro-3-methyl- phenol (2,6-Dichloro-m- cresol)	58, pet eth 58	234					l	100-1, al		90, ai 78 0 8 5, al	
62	2,5-Dichlorophenol	58-9, pet eth	212								69	
63	4-Propylcatechol (1,2- Dihydroxy-4-propyl- benzene)	60, bz	175-8030				!					3-Me eth, b p 240-2, Di-me eth, b p 247
64	1,2-Dihydroxynaphthalene (1,2-Naphthalenediol)	60 (hyd ), 103-4									di 106	
65	4-Isopropylphenol	(anh ) 61	223-5								71-2	

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thvl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	P- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
66	5,6,7,8-Tetrahydro-2- naphthol	61 5-2 5	275 <sup>705</sup>			113, 106 5				b p 15814	96	N,N-Diphenyl- urethane, 114, Cinnamate, 77 5
	2,3,5-Trichlorophenol 2-Methyl-3,5,6-trichloro- phenol (3,5,6-Trichloro-o-	62 (hyg) 62, ac a					:				103, lgr 110, al	Me eth, 84, al
69	cresol) 3,4-Dimethylphenol (o-4- Xylenol)	62 5, w	225757	120, dil al	141 2, lgr		181 6 (cor), al	tri 171		22	58 5	Aryloxyacetic acid, 162 5 2 4-Dinitrophenyl ether 105-6 p-Xenylure-thane, 183, al Picrate, 83 8, yel Me eth, 204 5, p-Phenylazobenzoate, 104-7
70	2,6-Dinitrophenol	63-4							135			Picrate, 122, Me eth., 118
71	4-Bromo-3-methylphenol (4-Bromo-m-cresol)	63 5, pet eth	118-237						84 5		83 5	Benzenesulfonate, 79-80, Me eth, b p 108 512
72	4-Bromo-2-methylphenol (4-Bromo-o-cresol)	64	235 (subl.)							bр 13212	67 8	Et eth, bp 238-40
73	1-Acetyl-2-naphthol	64, lgr	(0201)								85 6, pyr	
74	4-Bromophenol	64, 66 4	238	140	169	180	191	tri 171		22	58 5	Aryloxyacetic acid, 157, 2,4-Dinitrophenyl ether, 141, N,N-Diphenylurethane, 99, p-Phenylazobenzoate, 167 5-8 5
	2-Methyl-1-naphthol 4-Methylcatechol (3,4- Dihydroxytoluene)	64-5 65, bz	252	dı 166						81 2 dibp 260-4	94-5 di 58	Picrate, 133-4 Diaryloxyacetic acid, 58, Di-p- xenylurethane, 193
77	3-Bromo-2-nitrophenol	65-7, pet eth (anh), 35 (hyd), w							136 5- 7 5, al	!	133	Me eth , 73
78	4-Chloro-3-methylphenol (4-Chloro-m-cresol)	66, 55	235		153-4				98		86	2,4-Dinitrophenyl ether, 112, Ben- zenesulfonate, 66
79	4-Hydroxy-3-nitrobiphenyl	66								85-6, lgr	111	Me eth , 91-2
80	4-Methyl-2,3,5-trichloro- phenol (2,3,5-Trichloro-p- cresol)	66-7, ac a					   			37-8, w-ac	89, w -al	
81	2,6-Dichlorophenol	67	219-20, 80-54								74 0–4 5	Me eth, bp
82	3,5-Dimethylphenol (m-5- Xylenol)	68	219 5 (subl )	148, 151		109	195 4 (cor), al	tri 166	83, ac a	bр 130 <sup>26</sup>	24	Aryloxyacetic acid, 111, 81, 2,4-Di- nitrophenyl ether, 100, p-Phenylazo- benzoate, 104 5- 6 5, p-Xenylure- thane, 150
83	2-Bromo-6-nitrophenol	68, yel	<u> </u>		<u></u>	<u> </u>		<u></u>	L	39 5–40	<u> </u>	Me eth, 67

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

									<b></b>	<b></b>		<b>,</b>
No	Name	Melting point °C	Boiling point, °C	Phenyl ure thane	α Naph- thyl ure thane	p-Nitro ben zoate	3,5 Di- nitro benzoate	Bromo derivative	p- Toluene sul fonate	Acetate	Benzoate	Miscellaneous
84	3-Methylcatechol (2,3- Dihydroxytoluene)	68, bz										2-Me eth, 39, bp 204, Di-Me eth, bp 202-3
	3,5-Dichlorophenol 2,6-Di-iodophenol	68 68	233					tri 189	116	38 107, ac a	55	Me eth, 35, ac a, Et eth, 41-2, ac
87	2,4,5-Trichlorophenol	68, pet eth									92 3, al	157, Me eth,
88	•	68 5-9 0,	264 5-5 0							73 5	46	77-5, al Me eth, bp 12410,
89	naphthol 2-Bromo-4,6-dichloro-	74–5 68 9	268 d						82-3			Et eth, bp 259 <sup>705</sup> 2,4-Dinitrophenyl
90	phenol 2-Bromo-4-methyl-6- nitrophenol (2-Bromo-6-	69, yel	:						128	110-11		ether, 140-1
91	nitro-p-cresol)  2,4,6-Trichlorophenol	69 5, ac a . 68	245			105 6				b p 261-2	75 5, al	Aryloxyacetic acid, 182 6, 2,4-Dinitro- phenyl ether, 136, N,N-Diphenylure- thane, 143, Me eth, 61-2, al, Et
92	2,4,6-Trimethylphenol	70, 69	220	141-2 lgr				di 158			62, pet eth	eth , 43-4 Aryloxyacetic acid, 142
93	2,3,4,6-Tetrachiorophenol	70	15015	-6-						65 6	108	Me eth, 64-5, Et eth, 55, Benzene- sulfonate, 127
94	1-Chloro-2-naphthol	<b>7</b> 0, lgr , 72								42 3	99 100	Me eth , 70-1, Et eth , 58
95	Methyl 3-hydroxybenzoate	70	280	115-6, bz								,
96	2-Methyl-6-nitrophenol (6-Nitro-o-cresol)	70, w -al		υz					66, al		42, al	Me eth, 30, pet eth, Et eth, b p
97	3-Propylcatechol (1,2- Dihydroxy-3-propyl- benzene)	<b>7</b> 0–2, pet eth										249 50, yel 3-Me eth , b p 144-6 <sup>25</sup> , Di-Me eth , b p 134-7 <sup>22</sup> Aryloxyacetic acid, 132, p-Xenylure-
98	2,4,5-Trimethylphenol (Pseudocumenol)	71	232	110				35		34 0- 4 5, pet	63, al	thane, 196 Aryloxyacetic acid, 132, p-Xenylure- thane, 196
99	4,6-Dichloro-3-methyl- phenol (4,6-Dichloro- m-cresol)	72	235-6, 110 <sup>18</sup>						104~5, al	eth	57 5, al	n <sup>20</sup> 1 5722, <b>B</b> en- zenesulfonate, 86,
100	2,4-D1-iodophenol	72, w							165-7 (cor)	70-1, w-al	98	Me eth , 68, w -al , Et eth , 46, me al , 51
101	, , , ,	72									43	
102	phenol 3,5-Dimethylcatechol (4,5-Dihydroxy-m-xylene)	73–4, w								dı 161, ac a		4-Me eth , b p 227-8

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

_		T	1		α-Naph-	T	T		p-	1		
No	Name	Melting point °C	Boiling point, °C	Phenvl ure thane	thyl- ure- thane	p-Nitro- ben zoate	3,5 Di- nitro- benzoate	Bromo derivative	Toluene sul fonate	Acetate	Benzoate	Miscellaneous
103	5-Chloro-2-methylphenol (5-Chloro-o-cresol)	73 4	225					tri 190	110		53 4	Me eth, bp 206-8, Et eth, bp 210 20
	2,5-Dibromophenol	73 4	1		Ì	Ĭ	ļ		110	102.5		M41 07 4
105	•	73 5, w 73 8, bz	295 282		ļ	ļ				102 5 35	58, al	Me eth , 83-4
107	1,3-Dibromo-2-naphthol	75	273 262		ļ	ļ	ĺ	ļ	ĺ	102	36, ai	
	2,5-Dimethylphenol (p-2-	75, al -eth	212	160 1,	172 3	87	137 2	tri 178		1.02	61	Aryloxyacetic acid,
	Xylenol)			bz , 162, 166	lgr		(cor)					118 p-Xenylure- thane, 162, p- Phenylazoben- zoate, 95 5-7 5, Picrate, 81-2, or, al
109	<b>2,3-Dimethylphenol</b> ( <i>o</i> -3-Xylenol)	75, w -a1		193 5								Aryloxyacetic acid, 187, p-Phenylazo-benzoate, 134 6, Me eth, 29, b p 199, Et eth, 10, b p 212 5
110	8-Hydroxyquinoline (Oxine)	75 6, dil al	266 6752			174 5			115	<b>вр</b> 280	118 20, al	Picrate, 203 4, Methiodide, 143 d (hyd)
111	4-(Dimethylamino) phenol	76							130	78		(liya)
	3-Chloro-4-hydroxybi-	76 7,80	Į į		ļ						110 11,	2,4-Dinitrophenyl
	phenyl										95 7	ether, 109-11
113	3-Bromo-2,6-dichloro-	76 5, lgr	264-70751								102	Me eth, bp
	phenol	77								15		260 5 50
114	2-Methyl-4,5,6-trichloro- phenol (4,5,6 Trichloro-o- cresol)	77, pet eth								45, w - me al		Me eth 515, al
115		77, yel , w								81		Me eth, 74
116	3-(Diethylamino)phenol	78	276 80		,						22 3	Methylurethane,
1					Ì							85 6, Methiodide,
		-0 -1										140 3
117	3-Phenylphenol (3-Hy-	78, 75	>300			1			52 5		60 l, all	Et eth, 34
118	droxybiphenyl) 4-Bromo-2,6-dinitrophenol	78 yel					İ		136, al	110 5, bz	154, al	Me eth, 88, Et eth, 66
119	4-Chloro-2-iodophenol	78		128						57	88, 84	VIII , 00
	2,4-Diaminophenol (4 Hy-	78 80										Me eth, 68, Et
	droxy-m-phenylene- diamine)	unstable									3	eth, 67 8, 4,N-Acetyl, 249, N,N'-Diacetyl, 220-2, O,N,N'-Triacetyl, 180 2, N,N'-Dibenzoyl, 253-4, Picrate, 120 d, yel
121	4-Methyl-3-nitrophenol	79, yel,	ļ ļ				į		91	.	ļ	Me eth , 17, b p
	(3-Nitro-p-cresol)	eth										266 7
122	2,3,4,6-Tetramethylphenol	79 81	230 50	178 9,							71-2,	
}	(Isodurenol)		] ]	wh,				]	Ì		wh,	
123	2-Bromo-4,5-dimethyl-	80, pet		w -al				ļ		l	w -al   51	Me eth, bp 863,
123	phenol	eth			)	1				ĺ	]	o-Nitrobenzoate,
	•											151-2
			لــــــا		L							

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point °C	Phenyl ure thane	α Naph- thyl ure- thans	p-Nitro- ben zoate	3 5-Di nitro- benzoate	Bromo derivative	p Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
124	5-Bromo-2-methylphenol	80									41	
	(5-Bromo-o-cresol)		1									
125	4-lodo-2-nitrophenol	80 1									102 3	Me eth, 98, Et eth, 80
126	4-Hydroxy-3-methoxy- benzaldehyde (Vanillin)	81	285	116 7			:		115	102	78	Aryloxyacetic acid, 187 2,4-Dinitro-
127	3,5-Dibromophenol	81								53	77	phenyl ether, 131, 2,4-Dinitrophenyl- hydrazone, 271 d Me eth, 140
128	4-Chloro-2,6-dinitrophenol	81								110 11		Me eth, 66 Et
129	4-Methyl-2-naphthol	81 2		İ						117 8		eth, 54 5
	5-Chloro-2,3-dimethyl- phenol	81 2									88, al	
131	3-Methyl-2,4,6-tribromo- phenol (2,4,6-Tribromo- m-cresol)	81 5-2 0, al							113 4, al	68, al	84 5 al	p-Phenylazoben- zoate, 130-2
132	2-Hydroxy-1-naphthalde- hyde	82	192²							87, al <i>tri</i>	:	Me eth, 84 Et eth, 115, Oxime
122	2 4 Di i d	0.2					•			124, al	123	157, Picrate, 120
	3,4-Di-iodophenol 2-Hydroxvazobenzene (2-	83 83								- 20	93 pet	Me eth, 41, Et
	Benzeneazophenol)										eth	eth, 44 Cu deriv, 225 6, al
135	5-Propylresorcinol (1,3-	83 4, bz ,								dı 12-5		D1-Me eth, bp
	Dihydroxy-5-propyl- benzene, Divarinol)	(anh ), 51, w										14729
136	2,3,4-Trichlorophenol	83 5, lgr									141, al	Me eth , 69 5, al
137	4-Benzylphenol (4-Hy-droxydiphenylmethane)	84	321, 308								mono 87, pet	2,4-Dinitrophenyl ether, 75 6, Benzyl eth, 49 5, al
138	4-Chloro-2,3-dimethyl- phenol	84									102	, ,
139	2,4-Dimethyl-1-naphthol	84 5	169 7010	174 5						'		Me eth, bp
												150-112, Picrate 143 4, dk red
	4-Methyl-1-naphthol	84 5									81	
	1-Bromo-2-naphthol 3-Bromo-2-naphthol	85 85								56 94		Me eth , 85 Me eth , 77-8
	2-Nitroresorcinol (1,3-	85, or -red,						•		di 63		D <sub>1</sub> -Me eth , 131,
	Dihydroxy-2-nitro- benzene)	w -al						:				yel, al Dı-Et eth, 106-7
144	3-(Dimethylamino)phenol	85	265-8,							36 5,	94	Picrate, 162,
	(3-Hydroxydimethyl		13810					;		ьр 160°		Methylurethane, 87, Ethylurethane,
İ	antline)									100		150, 99 100, Me
										,		eth, bp 237, Et eth, bp 247
145	3-Hydroxy-2-nitrobiphenyl	85-6, bz ,		. !						61 5 2 5	131 0	Benzenesulfonate,
		81 2, yel,									2 5	130-1, 4-Nitro
		al										deriv , 126 7, 6-Nitro deriv , 214,
												4,6-Dinitro deriv,
146	2-Hydroxybenzyl alcohol	86 7, w									di 51,	168 70 Aryloxyacetic acid,
170	(Saligenin)	., "									70% al	
											<u> </u>	L

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, *C	Boiling point, *C	Phenyl ure thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	P Toluene sul fonate	Acetate	Benzoate	Miscellaneous
147	,	86 5								95-6	135, 132	
148	(4,6-Dinitro-o-cresol) 3-Nitrocatechol (1,2- Dihydroxy-3-nitroben- zene)	86 5, yel , pet eth								<i>dı</i> bp 103–4¹	2-mono 66	1-Me eth, 62, yel, 2-Me eth, 102-3, D1-Me eth, 64-5, al
149	4-Chloro-2-nitrophenoi	86–7			) 					47 8		Me eth, 98 Et eth, 61-2
150	2,4,5-Tribromophenol	87, CH <sub>2</sub> Cl <sub>2</sub> - pet eth						   			99	Me eth, 105, o-Br- p-toluenesulfonate, 107 8, al
151	4-Bromocatechoi (4-Bromo- 1,2-dihydroxybenzene)	87		Ĭ				<u> </u>			di 111	1-Me eth, 65
152		87, bz							135, bz - Igr	43, pet eth	173-4, 50% al	Aryloxyacetic acid, 213 4, Me eth , 37
153	2-Methyl-3,4,5-tribromo- phenol (3,4,5-Tribromo- o-cresol)	89, pet							Ü	3		
154	2-Amino-6-methylphenol (6-Amino-o-cresol)	89, w		ļ					89, 90	78-9		N-Acetyl, 100 1
155	1. '	89								93-6		Et eth, bp 215-6 <sup>20</sup>
156	3-Nitro-2,4,6-tribromo- phenol	89-90, lgr							146-7, al			Me eth, 82, al, Et eth, 79, eth
157	2-Amino-6-chloro-4- methylphenol (2-Amino-	89-90				i ,					:	N,O-Diacetyl, 162 3
158	6-chloro-p-cresol) 1,3-Dimethyl-2-naphthol	89~90		197					85 в			Picrate, 132-3
159	2-Propylhydroquinone (1,4- Dihydroxy-2-propyl- benzene)	90, bz										Di-Me eth , b p 240–6
160	1 '	90-1	136 <sup>8 5</sup>							<i>dı</i> bp 145-7 <sup>7</sup>	<i>dı</i> 96–7, eth	Di-Me eth , b p 242 4
161	3-Chloro-4,6-dimethyl- phenol	90-1										
162	2-Methyl-3,4,6-tribromo- phenol (3,4,6-Tribromo-o- cresol)	91, pet	i							76-7, ac a	85, 133, bz	Me eth,71,al
163	· '	92								69	į	Me eth , 105, Et eth , 112, 6-Nitro deriv , 113 5
164	4-Chloro-2,6-dibromo- phenol	92							107-8			2,4-Dinitrophenyl ether, 145-6 Me eth., 74
165	4-Bromo-2-nitrophenol	92, 89								75		Me eth , 88 Et eth , 47, Benzene- sulfonate, 83-4
	4-tert-Amylphenol 4-Hydroxyphenylethyl alcohol (Tyrosol)	92-3 93, chl	260-5 310, 156 <sup>15</sup>	108					<b>5</b> 5	β-mono 59, eth - lgr di b p 18718	61 di 111, al	4-Et eth , 40

<sup>\*</sup>Derivative data given in order: m.p , crystal color, solvent from which crystallized

No	Name	Melting point, *C	Boiling point, *C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
168	4-lodophenol	93 4, w		148, bz					99, me al	32	119	Aryloxyacetic acid 156, N,N-Di- phenylurethane 127, 2,4-Dinitro-
169	1-Naphthol (α-Naphthol)	94	278-80	177-8, al	152, lgr	143, 140	217 4 (cor), yel, al	2,4-di 105	89	48-9, al	56, al	henyl ether, 156 Aryloxyacetic acid, 193 5, p-Xenyl- urethane, 190 2,4- Dinitrophenyl ether, 128, p- Phenylazo- benzoate, 118-9
170	2-Iodo-4-nitrophenol	94, 86-7								68		Me eth, 97, Et eth, 96
171	2,4,6-Tribromophenol (Bromol)	95, HCOOH 94, ac a (+1 ac a)			153	153	174	tetra 120	113, al	82, 87 ac a	81, al	Aryloxyacetic acid, 200, N,N-Di- phenylurethane, 153, 2,4-Dinitro- phenyl ether, 137 8 p-Phenylazo- benzoate, 116-9
172	<b>2,2'-Stilbenediol</b> (2,2'-Dihydroxystilbene)	α 95, al, β 197, al									α di 107~8	β Di-Me eth 136
173	6-Chloro-1-naphthol	95	[		1					47	10, 0	Picrate, 165
174	3-Bromo-4-hydroxybi- phenyl	95								74 5	93 4	Benzenesulfonate 102 3
175	1,3,6-Trihydroxynaph- thalene (1,3,6-Naph- thalenetriol)	95			,					112-3		Me eth, 103-4
176	2,3,4-Tribromophenol	95, w - HCOOH				'						Me eth, 106
177	2,3,5-Trimethylphenol	95 6	233	174, pet ēth						241	50, pet eth	
178	2-Naphthyl salicylate (Betol)	95 5, stable, 93 5, labile		268, yel, ac a						136, al		
179	3-Amino-2,4,6-trichloro- phenol	95 5-6 0, lgr										N-Acetyl, 185 0 6 5, tol
180	3-Acetylphenol (3- Hydroxyacetophenone)	96	296, 1535							44 0–4 5	52-3	D <sup>109</sup> 1 099, n <sup>109</sup> 1 5348 Me eth b p 240, Semi- carbazone, 194-6
181	5-Iodo-2-nitrophenol	96, yel, pet eth								95	122	Me eth, 92, Et eth, 86-7
182	2-Methoxy-5-propenyl- phenol	96, 92	14719							101		Et eth , 49 50
183	2-Methyl-4-nitrophenol (4-Nitro-o-cresol)	96, yel, bz, 30-40 (+1 H <sub>2</sub> O), w	186 90						107, al		128	Me eth, 64, al, Et eth, 71, w-al
184	2-(Methylamino) phenol	96-7, 86 7, pet eth									157 9	N-Benzoyl, 160 1, Me eth , 33 0-3 5
185	3-Nitrophenol	97	194 <sup>70</sup>	129	167	174	159	dı 91	112 3	55-6	95	D100 1 2797, Aryloxybenzoic acid, 156, 2,4- Dinitrophenyl ether 136, p- Phenylazo- benzoate, 160 5- 2 5

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point, *C	Boiling point °C	Phenyl ure- thane	α-Naph- thyl- ure thane	p-Nitro- ben zoate	3,5 Di- nitro- benzoate	Bromo derivative	/ Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
186	2,3-Dibromo-5,6-dimethyl-	97, aq al								78, pet	153, al	
187	phenol 5-Methyl-1-naphthol	97-8		1	1	1	 	1	1	eth	77 8	}
	3-Acetylcatechol (2,3- Dihydroxyacetophenone)	97-8, yel , w							2	di 109, bz		I-Me eth, 152 3 Di-Me eth, 48, Oxime 96 7 Semicarbazone, 166 7
189	2-Cyanophenol	98			Ė				į		106, pet eth	D <sub>4</sub> <sup>996</sup> 1 1052 n <sub>α</sub> <sup>996</sup> 1 53716
190	3-Chloro-4,5-dimethyl- phenol	98	ļ	1	į	ŀ					42, al	
191	2,5-Di-iodophenol	99, pet eth								70, ac a		į
192	4- <i>tert</i> -Butylphenol	100	237	148 5	110			50 di 64 7	109 10	1	81-2	Aryloxyacetic acid, 86 5, 2,4-Dinitro- phenyl ether 108 10 Benzene-
193	3,4,5-Trichlorophenol	101, lgr , 91	271 7746								120, al	sulfonate 70 1 Me eth, 130, b p 256 61, m-Nitro- benzenesulfonate, 176
194	3,5-Dibromo-2-methyl- phenol (3,5-Dibromo-o- cresol)	101 98 101									91-3	
195	4,6-Dinitro-3-methylphenol	101 73 4			ļ				110 11		95	Me eth, 115 Et
196	(4,6-Dinitro-m-cresol)  2-Acetyl-1-naphthol	102, pa grn , al, 98, br - yel , bz	325, sl d							107 5, al	128, al	eth , 97
197	2-Methyl-3,4,5-trinitro- phenol (3 4,5-Trinitro-o- cresol)	102, or yel, acet										Me eth, 111 2, w-al
198	4-Methyl-2,3,6-tribromo- phenol (2,3,6 Tribromo-	102, pet							]	77, lgr		
199	p-cresol) 1-Nitro-2-naphthol	103, yel , al								61, pet eth	) 	m-Nitrobenzene- sulfonate, 176, ac a, Et eth, 104-5,
200	3,3'-Dihydroxydiphenyl- methane	103, yel , al								di 57 5 8 5, Igr		yel, al
	4-Chloro-2-naphthol 3,5-Di-iodophenol	104 104, w								56 79, me al	93	Me eth, 85, pet eth, Et eth, 30,
203	2-Bromo-4-methyl-5-nitro- phenol (2-Bromo-5-nitro-	104, yel								121		me al Me eth , 94, yel , eth
204	p-cresol) 3-Hydroxybenzaldehyde (3-Formylphenol)	104, 108 (cor)	240	158-60						b p 203	38, 48 5- 9 0	Aryloxyacetic acid, 148, 2,4-Dinitro- phenylhydrazone, 257d, Semicarba- zone, 198
205	5-Methyl-2-naphthol	104 5									107 8	Picrate, 156 7

<sup>\*</sup>Derivative data given in order  $\, m \, \, p$  , crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyi ure- thane	p-Nitro ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
206 207	3-Hydroxy-4-nitrobiphenyl Catechol (Pyrocatechol, 1,2-Dihydroxybenzene)	104 5, al 105	245 6	di 169	175	157 mono 159 di 169, al	199 di 152	tetra 192 3, wh - vlt		mono 57 8, di 65	mono 181, 131 di 84, al - eth	Aryloxyacetic acid 136 8 Monoben zenesulfonate monoacetate, 86 me al Dibenzene- sulfonate, 155-6, acet
208	2,4-Dibromo-1-naphthol	105, 111								92-3		Me eth, 54-5, al sym-TNB add comp, 97, Picrate, 97, yel
209	2,4-Dichloro-5-nitrophenol	105 6									111 2	m-Nitrobenzoate, 154, o-Nitro-p- toluenesulfonate, 143
210	Chlorohydroquinone	106								mono 62, di 72, 99		
211 212	4,6-Dinitro-2-iodophenol 1,6-Dibromo-2-naphthol	106 7, w 106-7 (+1 ac a, 84)							149	113 125		Me eth , 102, Et eth , 94
213	2-Amino-5-chloro-4- methylphenol (2-Amino-5- chloro-p-cresol)	106-7										etn, 94 N-Acetyl, 115, aq al, Me eth, 106, lgr
214	•	106-7 89	259, 147 <sup>18</sup>						dı 46 7	dı 66		3-Me eth , 79-80 Di-Me eth , b p
215	<b>2-Hydroxypyridine</b> (α-Pyridone)	106 7, bz	280 1			120			158-9, 53	b p 150- 60° °°	42	Picrate, 176 7, Benzyl eth , 42
216	2-Phenoxyphenol (2- Hydroxydiphenyl ether)	106 7	151 511							b р 358-60	48 5	Me eth, 79, Igr
217	5-Methylresorcinol (Orcinol, 3,5-Dihydroxy- toluene)	106 5 8, 56 8 (+1 H <sub>2</sub> O)	287-90	154	160, lgr	214	190	tri 104		dı 25	<i>di</i> 88, al	Aryloxyacetic acid 217 p-Xenyl- urethane, 196 2,4-Dinitrophenyl ether, 153 4
218	6-Amino-4-chloro-2- methylphenol (6-Amino- 4-chloro-o-cresol)	107		ļ				1		2,3 <i>-dı</i> 196		Chior, 133 4
219 220	2,4-Dichloro-1-naphthol	107-8 108, 105 5								74-6 di 104- 6, 109, ac a	dı 106	Me eth, 58 Diaryloxyacetic acid, 104 6, 1-Me eth, 90 5, Di-Me eth, 31
221	1,2,3,4-Tetrahydroan- thranol	108, lgr								109, al	142	Me eth, bp 19714
222		108				114 6					89	
223		109								54		Semicarbazone, 199, 2,4-Dinitro phenylhydrazone 261 5 (cor ), br , al
224	3-Methyl-2,4,6-trinitro- phenol (2,4,6-Trinitro- m-cresol)	109 10, yel, al								135, pa yel , bz	140	Di-Me eth , 155, al , Di-Et eth , 36 7, w -al

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point *C	Boiling point *C	Phenyl ure- thane	α-Naph- thyl ure thane	p-Nitro- ben- zoate	3,5-Dı- nıtro- benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
225 226	2-Iodo-6-nitrophenol Resorcinol (1,3-Dihydroxy- benzene)	109 10 110 (sta- ble), 108 8 5 (labile)	280 8 (cor), 275 9	dı 164, chl		dı 182 175	dı 201	tn 112	di 80- 1, acet - dil al	96-7 57-8, dıl al	mono 135-6, di 117, dil al	Me eth, 96-7 Aryloxyacetic acid, 175, 195, 2,4-Dini- trophenyl ether, 194, N,N-Di- phenylurethane, 194, Me eth, 43-
227	2,2 -Biphenol (2 2 Dihydroxybiphenyl)	110 109, tol	326	dı 145, dıl al	İ			dı 188	190	di 95, xyl	<i>dı</i> 101, al	4, me al Dı-Me eth , 155, al , Dı-Et eth , 36–7, w -al
228 229	Bromohydroquinone 4-Hydroxy-2'-nitro- biphenyl	110 110 1, 116						di 186		dı 72 122	156-7	Aryloxyacetic acid, 160-1, Benzene- sulfonate, 106, yel, al, Me eth, 60 0-0 5, Et eth, 51 5-nitro deriv, 151-2
	7-Methyl-1-naphthol	110-11								39-41		Picrate, 164-5
231 232	1-Methyl-2-naphthol 2-Chloro-4-nitrophenol	111 111, w	 							66 63	116 7	Picrate, 163 4 Me eth, 98, Et
												eth, 82, 142
233	2-Amino-6-nitrophenol	111-2 aq al								2-mono 102-3 (hyd), 122 (anh)		Me eth , 198
234	2,4,6-Tribromoresorcinol (1,3-Dihydroxy-2,4 6-tri- bromobenzene)	112, w								mono 114, CS <sub>2</sub> , di 108	mono 120, chl - pet - eth	Me eth, 104, D1- Me eth, 68-9, w - al
235	4',5-Dimethyl-2-hydroxy- azobenzene (2-p-Toluene- azo-p-cresol)	112 3, tol								91,yel, aca	95, yel , al	Et eth, 43, ac a, Propionate, 62, lgr
236	4-Hydroxyphenanthrene (4-Phenanthrol)	112-3 5, pet eth								58-9, al		Me eth, 68, me al
237	2,2'-Dihydroxy-3,3'-	113, pet									dı 147,	
238	dimethylbiphenyl  2,6-Dinitro-4-iodophenol	eth 113, w							138		me al	
239	2-Chloro-4,6-dinitrophenol	113, 110							155	1. 76	4 127	
240	4,4'-Dihydroxy-2,2'- dimethylbiphenyl	114								dı 75	di 127	
241	2-Bromo-4-nitrophenol	114								62, 86	131–2	Me eth, 106, Et eth, 98, yel
242	4-Nitrophenol	114		156	150-1	159	186, 188 (+1 ac a)	2,6-dı 142	97	81-2, w -al	142 5	Aryloxyacetic acid, 187, 2,4-Dinitro- phenyl ether, 120, N,N-Diphenylure- thane, 112, p- Phenylazoben- zoate, 203-6
243	2,4-Dinitrophenol	114				139		6-mono	121	72	132	2,4-Dinitrophenyl
244	2,3,5-Tri-iodophenol	114, bz - lgr						118		123		ether, 248 Et eth , 121

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting	Boiling	Phenyl ure-	α-Naph-	p-Nitro- ben-	3,5-Di nitro-	Bromo derivative	p- Toluene	Acetate	Benzoate	Miscellaneous
=		point, °C	point, °C	thane	ure- thane	zoate	benzoate	derivative	sul- fonate			
245	4-Hydroxy-3-methoxy- benzyl alcohol	115								4-mono 51, di 48, bz -	4-mono 90, et ac -al,	4-Et eth, 56 7
246	1-Hydroxyfluorenone	115, yel								lgr 130-1, aq al	di 121 128-9	Me eth, 141 5 2 5 Oxime, 169-70, Phenylhydrazone, 173-4
247 248	Ethyl 4-hydroxybenzoate 4-Chloro-3,5-dimethyl- phenol	115, 116 115-6	297-8							47 8	94, eth	
249	3,5-Dimethyl-2,4-dinitro-	115-6, 106							171	148	156	
250	phenol 4-Bromo-1,5-dihydroxy- naphthalene (4-Bromo-	116								dı 138		Di-Me eth, 115
251	1,5-naphthalenediol) 3-Benzoylphenol (3-Hy	116 al										Oxime anti 76 bz syn 126 (on heat- ing anti)
252	4-Hydroxybenzaldehyde	116-7									90	Aryloxyacetic acid 198, 2,4-Dinitro- phenylhydrazone
253	3-Bromo-1,2-dihydroxy- naphthalene (3-Bromo- 1,2-naphthalenediol)	117								di 160		270 1 Naphthalene add comp, 100
255	Phloroglucinol (1,3,5- Trihydroxybenzene)	117 (+2H <sub>2</sub> O), 217-9				283		tri 151		tri 104	tri 185	Picrate, 101-3
256	2,4'-Dihydroxydiphenyl- methane	(anh ) 117-8, w - al								<i>dı</i> 70, aca	dı 108	Di-Me eth, 26 Di-Et eth, 60, w
257	2,3,5,6-Tetramethylphenol (Durenol)	118, wh , pet	249					4- <i>mono</i> 118, or, dil al				al
258	4-Amino-2-methyl-6-nitro- phenol (4-Amino-6-nitro- o-cresol)	118, al						dii ai		4-mono 217, yel, al		
259	2,4-Dibromo-6-nitrophenol	118, ac a							140	89		Me eth , 76-7, yel , Et eth , 46
260		118, yel ,							123-4, al	74		Me eth, 74, al, Et eth, 61, al
261	(5-Nitro-o-cresol)  2-Bromo-4,6-dinitrophenol	lgr 118-9, yel							157	104 5	94, aq al	Me eth, 48, yel
262	2-Bromo-5-nitrophenol	118 5-21, pet eth							131 5- 2 5,		α.	Me eth , 104, al
263	2-Amino-4-methyl-6-nitro- phenol (2-Amino-6-nitro-	119, 110, br , al							al			N-Acetyl, 143, yel al
264	p-cresol) 3-Amino-2,4,6-tribromo- phenol	119, pet eth							146-7, al			O,N,N-Triacetyl, 136

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
265	2-Methylresorcinol (1,3- Dihydroxy-2-methyl- benzene, 2,6-Dihydroxy- toluene)	119 20, bz	271 (cor )								di 105-6, me al	D <sub>1</sub> -Me eth , 39
266	4-Acetylcatechol (3,4-D1-hydroxyacetophenone)	1192 7 116							di 144- 5, et ac	4-mono 58, di 91, 88	di 118, al	Oxime, 184 d, et ac, 1-Me eth, 91, 2-Me eth, 115, Di- Me eth, 51
267	2-Chloro-5-nitrophenol	119 5, w								82	127-8	Me eth, 83, Et eth, 645, al
268	5-Methyl-1,2,3-trihydroxy- benzene (3,4,5-Tri- hydroxytoluene, 5- Methylpyrogallol)	120 (subl ), bz						İ		tri 99		3,5-Di-Me eth , 36, al
269	9-Hydroxyanthracene (9- Anthrol, Anthranol)	120, yel								126 31	286 8	
270		120 d , yel , lgr								137		
271	· '	120									dı 148, al-	
272	4-Nitro-2-naphthol	120, yel, pet eth							122, pa yel,		acet	m-Nitrobenzene- sulfonate, 149, ac a, Me eth, 100-3,
273	4-Chloro-1-naphthol	120 1, 116 7, al or chl		ĺ					al	44		br, bz-al Picrate, 171, Car- bonate, 228
274	2-Chloro-3-nitrophenol	120 5, w								51 5	94	Me eth, 94, Et eth, 51, me al
275	4-Chloro-3,5-dibromo- phenol	121				:					132	Me eth, 82 5
276	3,4-Dimethyl-1-naphthol	121 5 3 0, lgr	205 1015				222 4			89 5 91		Turns red in air, Picrate, 168
277	3-Aminophenol (3- Hydroxyanılıne)	122				143	179					N-Acetyl, 148, N-p- Toluenesulfonyl, 157, N-Phenyl- thiourea, 156
278	2-Amino-3-chlorophenol	122										N-Acetyl, 123, N-Benzoyl, 123,
	4-Bromo-2-naphthol 4-Nitroresorcinol (1,3-Di-hydroxy-4-nitrobenzene)	122 122, yel , CCl <sub>4</sub>	178-9''							61 di 90-1, al	124, ac a, 3-	HNO <sub>3</sub> salt, 137 Me eth , 64 Di-Et eth , 85
281	2,4,6-Trinitrophenol (Picric acid)	122 (subl on slow htng , exp on rapid htng )								76	mono 189, ac a, di 110	Naphthalene add comp , 149-51

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

				Phenyl	α-Naph	p-Nitro	3 5-D1-	T	p Toluene	<u> </u>		
No	Name	Melting point °C	Boiling point °C	ure thane	thyl ure- thane	ben zoate	nitro- benzoate	Bromo derivative	Toluene sul fonate	Acetate	Benzoate	Miscellaneous
282	3-Hydroxyphenanthrene (3-Phenanthrol)	122 3, al								114 5, aq al		Me eth, 63, me al, Et eth, 46, me al, Picrate, 124-5, red, al
283	2,4-Dichloro-6-netrophenol	122 3								77		3-Nitrobenzoate, 149-50
284	<b>2-Naphthol</b> (β-Naphthol)	123	286	155-6, al	156 7, lgr	169	210 2 (cor), al	84	125, al	71 2 70	106-7	Aryloxyacetic acid, 95, 2,4-Dinitro- phenyl ether, 95, N,N-Diphenylure- thane, 141, p- Phenylazoben- zoate, 190 3
285	2,3,4,5-Tetrabromophenol	123, aq al						225 6		110 5, aq ac a	133, al	
286	2,4-Dimethyl-2-methoxy- phenol	123							137 8	114		Et eth, 91
287	2-Nitro-4,5,6-tribromo- phenol	123, yel , bz										Me eth, 109, al, Et eth, 74
288 289	1,4-Dichloro-2-naphthol 4-Butyl-2-methylphenol	123 4 124	127 915							90 1 268 70		
290	(4-Butyl-o-cresol) 3,3'-Biphenol (3,3'-D1-	124, w								dı 82 5,	dı 92	D1-Me eth , 36, w -
291	hydroxybiphenyl) 1,3-Dihydroxynaphthalene	124, w								dıl al		al, b p 328 sym-Trinitroben-
27.	(1,3-Naphthalenediol)	124, #	,							w-ac		zene add comp, 174 5, red
292	3-Iodo-4-nitrophenol	124, yel,								73 7	119	Me eth, 69-70
293	2-Methylhydroquinone (2,5-Dihydroxytoluene)	pet eth 124 5, bz						84	125	mono 92, pet eth, di 49, 45, w	di 119- 20	Aryloxyaçetic acid, 153, Di-Et eth, 24 5, b p 247-9
294	<b>4-Hydroxybenzyl alcohol</b> (α,4-Dihydroxytoluene)	124 5 5 5								α-mono 84, di 75	α-mono 88 9	
295	4,6-Dimethylresorcinol (4,6-Dihydroxy-m- xylene)	124 5-5 0, w (+1 w)	276 9							di 45, al, bp 285-7		D <sub>1</sub> -Me eth , 76, D <sub>1</sub> - Et eth , 75, al
296 297	4-Benzyl-1-naphthol Pentamethylphenol	125-6 126	267	215						87–8 273	103 127	Me eth , 163 4
	3,5-Dinitrophenol	126, 122	207	213						126 7	127	Me eth, 105-6, Et eth, 97
	7-Chloro-2-naphthol 4-Chloro-3-nitrophenol	126 5 126 5 w								104 5 83 5	96-7	Me eth, 98, al,
l	2-Nitro-3,4,6-tribromo-	127, pa								118	,	Et eth, 47 5, al Me eth, 72, w -
301	phenol	yel,w-								110		HCOOH
302	2-Nitro-1-naphthol	HCOOH 127-8, yel,								118		Me eth, 80, Et
303	1,3-Dibromo-2,4-dihy- droxynaphthalene (1,3- Dibromo-2,4-naphtha- lenediol)	al 128 9, ac a						186, CS <sub>2</sub>		4-mono 148, dı 125, al		eth, 84, yel, lgr

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	Phenyl ure thane	α Naph thyl ure thane	p Nitro ben zoate	3 5 Di nitro benzoate	Bromo derivative	p Toluene sul fonate	Acetate	Benzoate	Miscellaneous
304	4-Iodo-2-naphthol	128 5								59		Me eth, 67
	4-Bromo-1-naphthol	129			]					51	<u>.</u>	
306	3-Methyl-4-nitrophenol	129, w			1					34, al	74	Me eth, 55, lgr,
	(4-Nitro-m-cresol)							į	l			Et eth, 45, al
307	<b>3-Hydroxypyridine (β-</b> Pyridone)	129				ļ				bр 210,	50 0- 0 5	Hydrochloride, 105-7, Picrate,
308	4-Hydroxy-3-nitroazo-	129, lgr				:				92° 120 5,	132, bz	200-1 Me eth, 107
309	benzene 3-Amino-2-methylphenol	129, w								ас а 108		Turns br in air
	(3-Amino-o-cresol)		}	1	<b>\</b>	\	ì	1	1		1	Mr45 100
	6-Bromo-2-naphthol	129 30		İ		1		ł		103		Me eth, 108 m-Nitrobenzene-
311	8-Nitro-1-naphthol	130										sulfonate, 166, ac
312	4-Amino-2-nıtrophenol	131, dk red										Me eth, 243, Et eth, 170, N-Acetyl, 157-8, yel
313	Methyl 4-hydroxybenzoate	131		134-5, bz						85	135	, ,.,
314	5-Methyl-1,2,4-trihydroxy- benzene (2,4,5-Trihy-	131 2, bz		OZ.		i				<i>tri</i> 114 5, al		4-Me eth, 124, w, 4-Et eth, 131 (subl), bz, Tri-
	droxytoluene)									"		me eth, 55, w -
315	5-Chloro-1-naphthol	131 2, w or CS <sub>2</sub>								53		Picrate, 160
316	4-Cyclohexylphenol	132		145 5		137, al	168 (cor )			35	118 5, me al	
317	Pyrogaliol (1 2,3-Tri- hydroxybenzene)	133	309	tri 173		iri 230	in 205	di 158		di 110- 11, tri 165, 173	mono 140, di 108, tri 90, al	Tris-N,N-Diphenyl- urethane, 212
318	2-Amino-4,6-dimethyl- phenol	134-5, al										N-Acetyl, 96, aq al, O,N-Dibenzoyl, 153 5 Me eth, b p 239-40
319	4-Amino-5-Isopropyl-2- methyl-6-nitrophenol (4-Amino-5-Isopropyl- 6-nitro-o-cresol)	134 5 yel, al		 							1-mono 280-3, di 222 5, bz	
320	4,6-Dibromo-2-naphthol	134-5								128	128 9	Me eth, 103, Et eth, 98
321	2,3-Dichloro-1,4-dihy- droxynaphthalene	135, 155-6, ag al								dı 239-40	dı 252	Di-Me eth, 107-8, Dipropionate, 166-7, Dibutyrate,
322	4-Benzoylphenol (4-Hy-droxybenzophenone)	135								81, me al	115, 94-5	128 2,4-Dinitrophenyl- hydrazone, 242 4 (cor), Semicar- bazone, 194

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl ure- thane	α Naph thyl ure thane	p-Nitro ben- zoate	3,5 Di nitro benzoate	Bromo derwative	p Toluene sul fonate	Acetate	Benzoate	Miscellaneous
123	2-Amino-4-methylphenol (2-Amino p-cresol)	135, w										N-Benzoyl, 191, al O,N-Dibenzoyl, 190-1, al, O,N- Diacetyl, 128-9, Me eth, 93-4,
324	3-Amino-4,6-dichloro- phenol	135-6 w	1			<b> </b> 			113-4			N-Acetyl, 233-6, Me eth, 51
325	_	135 6 (anh)								4-mono 95-6, di	4-mono 150 1	4-Me eth , 102, Di- Me eth , 95-6 112
26 27	1,4-Dimethyl-2-naphthol Trichlorohydroquinone	135 6 136, w								135-6 77-8 di 153 (subl)	124-5	Di-Et eth, 68 5, al
28 29	5-lodo-3-nitrophenol Trichlorophloroglucinol	136, w 136, al								110 tri 167 8,	100 5	Me eth, 84 Di-Me eth, 93-5 Tri-Me eth,
130	1,6-Dihydroxynaphthalene (1,6-Naphthalenediol)	137-8, bz								ac a di 73, al	dı 103-4	130-1, al Di-Me eth, 60-1 pet eth, Di-Et eth, 83, lgr, 2- Naphthylamine
331	2,4-Dinitro-1-naphthol	138									174	add comp, 110 5 Me eth, 97, Et eth, 92
332	4-Amino-2,6-dimethyl- phenol	138 d , bz										N-Acetyl, 136-7, aq al, O,N-Di- acetyl, 160, Me eth, 66, w
ı	2-Amino-3-bromophenol	138							120–1, al	}		Me eth, 65, Hy- drochloride, 225
334	2-A mino-4-chlorophenol	138 (unstable)							115	73-4		N-Acetyl, 185, O,N-Dibenzoyl, 157-8, Me eth, 82-3
335	1,4,6-Trihydroxynaphtha- lene (1,4,6-Naphthalene- triol)	138-40								94 5		
36	2,6-Dibromo-3,4,5-tri- hydroxybenzoic acid (Dibromogallic acid)	139 d (+1H₂O)								<i>tr</i> i 168	tri 95-6	Triacetate of Me eth, 150–2
337	2-Hydroxy-2'-nitro- biphenyl	139–40				116	180	3,5-di 149	100		116	3-Nitrobenzenesul- fonate, 161, 4- Nitrobenzenesul- fonate, 147, 2,4- Dinitrophenyl ether, 118, Me eth, 82, 3,5-Di- nitro deriv, 123
	4-Phenyl-1-naphthol 1,3-Dihydroxy-2-methyl- naphthalene (2-Methyl-	140 140								118	73-4	intro deriv , 123
40	1,3-naphthalenediol) 1,2,4-Trihydroxybenzene	140-5, eth	-							<i>tri</i> 96–7, wh,	tri 120,	Tri-Et eth, 34, al, Picrate, 96
341	2-Amino-5-iodophenol	141	,							abs al		N-p-Toluenesul- fonyl, 175-6

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	Phenyl ure- thane	α-Naph thyl ure- thane	p Nitro- ben- zoate	3 5-Di- nitro- benzoate	Bromo derivative	P Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
342	4-Hydroxy-2-nitro- biphenyl	141-3								169	105 6	Me eth, 72
343	· · · ·	142, ac a , 140, w				i				di 155 ac anh	di 174 5	Di-Me eth, 50, pet eth Picrate, 135 7 2-Naphthyl- amine add comp, 124
344	2-Amino-4-nitrophenol	142 3 (anh ), 80- 90 (hyd )				122			122, yel, al			N-Acetyl, 279, N-Benzovl, ca 200d, Me eth 124 5 Et eth, 97 8
345	3,4-Dihydroxy- phenanthrene (Morphol)	143, pet eth				,		•		di 159, eth		Me eth, 62 3, Di- Me eth, 45, me al
346	3-Chloro-1-naphthol	143, 134 5, Igr			ļ					69, lgr	118 9	Me eth, b p
347	2-Isopropyl-5-methyl- hydroquinone (Thymo- quinol)	143, 139 5	290	232 3, al	147 8, al					di 73 5	141 2, al	102-4
	2,6-Dibromo-4-nitrophenol 3,4,5-Tribromocatechol	144 144							128 9	181 di 120		D1-Me eth , 86-7
	3-Amino-4-methylphenol (3-Amino-p-cresol)	(+1H₂O) 144										N-Acetyl, 178 O,N- Diacetyl, 128 9 N-Benzenesul-
351	8-Nitro-2-naphthol	144-5, yel								101-2, w -al		fonyl, 183, Me eth, 47, w m-Nitrobenzene- sulfonate, 144-6, ac a, Me eth, 69, Et eth, 72-3, yel,
352	4-Benzoylresorcinol (2,4- Dihydroxybenzo-	144 6						}		dı 78	Į.	pet eth
353	phenone) 1-Hydroxyacenaphthene	144 5-5 5		137						bр		
354	(1-Acenaphthenol) 4-Amino-2,3,6-trinitro- phenol	(cor), 148 145 d, ac a								166-85		N-Acetyl, 178-9, N-Benzoyl, 205, ac a, Me eth, 138-9,
355	4-Benzoylcatechol (3,4- Dihydroxybenzo-	145, 134									di 95	Me eth, 131-2, Di- Me eth, 103 4
356	phenone) 3-Bromo-5-nitrophenol	145								99		Me eth, 88
357	3,4-Dihydroxybiphenyl (4-Phenylcatechol)	145								di 775 80	ļ	
358 359	· · · · · · · · · · · · · · · · · · ·	145, CS <sub>2</sub> 145								di 170 di 94 5	di 120	4'-Me eth, 148 d,
360	2,6-Diamino-4-methyl- phenol (4-Hydroxy-3,5- toluenediamine)	146										al N,N'-Diacetyl, 225- 7, dil al , 1,2,6- Triacetyl, 228, al
361	5-Aminoresorcinol (3,5- Dihydroxyanılıne)	146-52										N-Benzoyl, 139, Di- Me eth, 46, Picrate, 167-70 d, yel, aq al

 $<sup>^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

Νo	Name	Melting point °C	Boiling point, °C	Phenyl ure- thane	α-Naph thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
362	4-Acetylresorcinol (Resacetophenone, 2,4- Dihydroxyacetophenone)	147								3-mono 119 20, 4- mono 74, di 38	3-mono 67, 4- mono 106 7	Semicarbazone, 216, 2,4-Dinitro- phenylhydrazone, 218, Oxime, 199, Phenylhydrazone, 159
363	3-Chloro-5-nitrophenol	147								84	78	Me eth , 101, Et
364	5-Nitro-2-naphthol	147, yel , w										eth, 47, al  m-Nitrobenzene- sulfonate, 106, ac a, Et eth, 115, yel, al
365	2-Methyl-3-nitrophenol (3-Nitro-o-cresol)	147, yel, w							94, al			Me eth, 52 3, w -
366	2-Chloro-4-hydroxybenzal- dehyde	147 8								52	97	Semicarbazone, 214, Oxime, 194, p-Nitrophenyl-
367	1,5-Dibromo-4,8-di- hydroxynaphthalene	147 5								dı 131		hydrazone, 288 d
368	5-Acetylresorcinol (3,5- Dihydroxyacetophenone)	148								di 91 2		Semicarbazone, 205 6 p-Nitro- phenylhydrazone, 236 7
369	2,4-Dinitroresorcinol	148							mono 126-7	di 119 20	<i>dı</i> 182 4	Aryloxyacetic acid, 155, Me eth , 108, Di-Et eth , 57
370	4-Propionylphenol (4- Hydroxypropiophenone)	148								62, lgr	107 5	2,4-Dinitrophenyl- hydrazone, 229
371	9,10-Dihydroxyphenan- threne (9,10-Phenan- threnediol)	148								mono 168 70, di 202	di   216 7	11, 0, 0, 0, 0, 0
372	3,4,5-Trihydroxyphenan- threne (3,4,5-Phenan- threnetriol)	148, w								tri 138, bz - pet eth		Tri-me eth , 90, me al
373	<b>4-Hydroxypyridine</b> (γ-Pyridone)	148 5 (anh ), 65 (+1 H <sub>2</sub> O)	> 350								81	Picrate, 240, Methiodide, 108 9
	3-Nitrosalicylic acid	148 5-9 0										Amide, 155, 145
375	3-Acetamidophenol (3- Hydroxyacetanilide)	148 9, w								99 5 100 5		
376	2-Amino-3,6-dimethyl- phenol	149 50, bz										N-Benzoyl, 210-11, O,N-Dibenzoyl, 178-9
377	2,6-Dimethylhydroquinone	149-51, xyl										4-Me eth, 77, pet eth
378	2,4'-Dihydroxybenzo- phenone	150				1				84 5		Cill
	5-Amino-2-bromophenol	150 d							135 6			
380	2-Amino-5-bromophenol	150				1	and the second			ĺ		O,N-Dibenzoyl, 133 4, H <sub>2</sub> SO <sub>4</sub> salt, 239 40
381	1-Hydroxyanthracene (1-Anthrol)	150-3, br ,				1			ľ	128-30		Me eth, 70, Et eth, 69
382	2-Amino-4-chloro-6-nitro- phenol	152							Ì			N-Acetyl, 150 60, yel

<sup>\*</sup> Derivative data given in order  $\, m \, p \,$ , crystal color, solvent from which crystallized

No	Name	Melting point *C	Boiling point, *C	Phenyl ure thane	α Naph thyl- ure	p-Nitro ben zoate	3 5-D1- nitro- benzoate	Bromo dersvative	p Toluene sul	Acetate	Benzoate	Miscellaneous
					thane				fonate	ļ	-	
383	4-Hydroxyazobenzene (4-Benzeneazophenol)	152, al								89, 84 5, yel , al	136-8, yel, al	Hydrochloride, 169 HNO <sub>3</sub> → 2,4-Dini- trophenol, 113 Propionate, 75, red
384	Tribromophloroglucinol	152 3 (anh ), w								mono 169, bz - pet eth , tri 181 3, al		Me eth, 123, bz Trı-Me eth 145, al Dı-Et eth, 63 5, w -ac a, Trı-Et eth, 102 4, ac a
385	4-Amino-2-chlorophenol	153	<u>.</u>						116-7, aq al	<u> </u>		N-Acetyl, 144 O,N-Diacetyl, 124 Me eth, 62
	2,2'-Dihydroxy-5,5'- dimethylbiphenyl 2-Amino-5-chlorophenol	153–4, w 154, aq al								dı 88		Diformate, 61, 70% al O,N-Dibenzoyl, 140, al Me eth, 46, Hydrochloride 226 d
388	1,2,4-Trihydroxynaph- thalene (1,2,4-Naph- thalenetriol)	154						-		<i>tri</i> 134 5		220 d
389	6-Hydroxybiphenyl-2- carboxylic acid	154 (anh )							177, ac a	88-9, al	121, 150	Benzenesulfonate, 104-5 Butyrate, 59-60
390	4-Amino-3-nitrophenol	154, dk red							134, al	185		N-Acetyl, 218, yel, w O N-Diacetyl, 146, O-m-nitro- benzenesulfonate, 184
391	2-Azoxyphenol (2,2'-D1- hydroxyazoxybenzene)	154 5								<i>dı</i> 150, bz	<i>dı</i> 108 al	Di-Me eth 81 Di- Et eth, 102
392	3,5-Stilbenediol (3,5-Di- hydroxystilbene, Pino- sylvyn)	155 5-6 0, ac a								<i>dı</i> 100-i me al	di 150 l ac a me al	Me eth, 122-3, ac a Di-Me eth, 56 7 me al
393	1-Hydroxyphenanthrene (1-Phenanthrol)	156, eth								135-6, al		Me eth, 105, me al, Picrate 182, or -red, me al
394	4-1odo-3-nitrophenol	156, yel , al								107 5		Me eth, 62, Et eth, 635
		157–8, ac a 158, bz, 153								129 77-8, al	99-100	Me eth, 95-6, me al, Picrate, 185, red, Propionate,
397	5-Nitroresorcinol	158, w								dı 105		95, ac a Me eth, 141-2, yel, Di-Me eth, 89, eth -et ac, Et
398	4,4'-Dihydroxydiphenyl-	158, w								di 69-	di 156,	eth, 80, w Di-Me eth, 52, Di-
399	methane 2,4,6-Tri-iodophenol	158-9, w - al					181			70, al 156, bz	al 137	Et eth, 38-9 Me eth, 98-9, bz Et eth, 83, eth

ullet Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
400	Salicylic acid (2-Hydroxy- benzoic acid)	158 3	21120			205, me al				135, wh	132	Aryloxyacetic acid, 191, Amide, 142, Anilide, 136, p- Toluidide, 156
401	4-Amino-2,3,6-trichloro- phenol	159, al								153, yel		N-2,4-Dinitro- phenyl, 211, or - red
402 403	4-Amino-3-chlorophenol 6-Amino-2,4-dinitro-3- methylphenol (6-Amino- 2,4-dinitro-m-cresol)	160 160, al										N-Acetyl, 121 N-Acetyl, 225, yel
404	2,2'-Dihydroxychalcone 4-Amino-6-nitroresorcinol	160-1 160-1 d ,								di 85 5 6 0	di 114	2-Me eth, 112, al 2-Et eth, 61, al N-Acetyl, 261, yel,
		eth -lgr								4 121	195	ac a, Di-Me eth 136 7, red aq al
	4,4'-Dihydroxy-3,3'-di- methylbiphenyl	160-1								di 131, al, 135 5	185, ac a	
	2,3-Dihydroxynaphthalene (2,3-Naphthalenediol)	160 l, w									di 235	Me eth, 108, Di- Me eth, 116 5, Igr, Et eth, 109- 10, Di-Et eth, 96-7, 2-Naphthyl- amine add comp 168
408	1,2-Dihydroxyanthracene (1,2-Anthracenediol)	160-2								di 157 0- 7 5, al - ac a		
409	<b>6-Retenol</b> (6-Hydroxy-retene)	161, xyl							110 5 11	134-5		Picrate, 152-2 5, red, al
410	5-Amino-2-methylphenol (5-Amino-o-cresol)	161, w				ili	:		111-2, aq al			N-Acetyl, 225, N,N-Diacetyl, 132-3, O,N-Di- benzoyl, 162, Me eth, 58
	4,4'-Dihydroxytriphenyl- methane	161, w -al								di 109 10		Di-Me eth, 100 1, chl-me al
	3-Hydroxyphthalic acid 1,2,3,4-Tetrahydroxy- benzene (Apionol,	161 d 161, pink, et ac								114–6 <i>tetra</i> 142	148 tetra 191 2	1,4-D1-Me eth , 106, Tetra-Me eth , 89
414	Phenetrol) 5-Amino-2-nitrophenol	162, or - yel , w										N-Acetyl, 221, yel, ac a, O,N-Di- acetyl, 149, w
415	1,3,4-Trichloro-2-naphthol	162								133 5- 4 0, ac a		
416	2-Amino-5-methylphenol (6-Amino-m-cresol)	162 d								ac a		N-Benzoyl, 169, acet -pet eth, O,N-Dibenzoyl, 162 3, me al, Me eth, 171, 50% al
417	1-Amino-2,4-dihydroxy- naphthalene	162 (at 130 → vlt )										O,O,N-Triacetyl, 155-6, bz

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p Toluene sul- fonate	Acutate	Benzoate	Miscellaneous
418	2,4'-Biphenol (2,4'-D1-	162 3	342			-				di 94,		Di-Me eth , 70
419	hydroxybiphenyl)  2,5-Dimethylresorcinol	163, bz	277 80							al di 69,		Me eth, 118-21,
420	(2,6-Dihydroxy-p-xylene) 2-Amino-3,5-dimethyl- phenol	163, bz					!			al 186 7		bz O,N-Diacetyl, 87-8, N-Benzoyl, 211 2, al O,N-Di- benzoyl, 148-9, me al, Hydro- chloride, 270 80,
421	4-Nitro-1-naphthol	164, w										dil HCl m-Nitrobenzene- sulfonate, 135, Me eth, 81, yel, bz 85-6, Et eth,
422	3,5-Dinitrocatechol (1,2-Dihydroxy-3,5-dinitrobenzene)	164								120, <i>dı</i> 112 4, 124, al		120, al , 116 7 1-Me eth , 123, 2- Me eth , 80 Di- Me eth , 102, al , 1-Et eth , 155, al , Di-Et eth , 78 94 5
423	2,2'-Dihydroxy-6,6'- dimethylbiphenyl	164					:			dı 87, al	<i>d</i> : 136, al	74.3
424		164					i			di >200 d	<u>.</u> .	N-Acetyl, 170 d , 3-O,N-Diacetyl, 195 d , acet
425 426	2,6-Dibromohydroquinone 2-Benzoylphloroglucinol (2,4,6-Trihydroxybenzophenone)	164 165					İ			dı 117	iri 125- 6	2,4-D <sub>1</sub> -Me eth , 83, 2,6-D <sub>1</sub> -Me eth , 178-9
427	• :	165, yel										N-Acetyl, 260-70, et ac
428	2-Methoxy-4-nitrophenol	165 d , yel , chl								156-8	188, yel, al	Me eth , 105 6
429	3-Amino-4,5-dimethyl- phenol	165, eth , br , (173- 5, subl )									yer, ar	N-Acetyl, 191 (sinters, 184), O,N-Diacetyl, 157, al, O,N,N-Triacetyl, 100-1, al, N-Benzoyl, 195-6
430	1,2,3,5-Tetrahydroxy- benzene	165								tri 74		1,3-Di -Me eth , 159, 83, 1,2,3-Tri- Et eth , 105
431	4-Phenylphenol (4- Hydroxybiphenyl)	165	305 8	167 5					177, ac a, 179, al-	88-9, 87-8, al	150-1, al	p-Phenylazo- benzoate, 213 5- 4 0, 2,4-Dinitro- phenyl ether, 118
432	4-A mino-2-bromophenol	165, 155							acet			N-Benzoyl, 145, O,N-Dibenzoyl,
433	Benzeneazocatechol (3,4- Dıhydroxyazobenzene)	165 d , dk red, al										192 3-Me eth, 70-1, red, lgr, Di-Me eth, 53-4, red, lgr, 44-5
434	4-A mino-2-chloro-3- nitrophenol	165 5 d , bz									_	N-Acetyl, 184-5, Et eth, 74, or

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

												<u> </u>
No	Name	Melting point *C	Boiling point °C	Phenyl ure- thane	α-Naph- thyl ure- thane	p-Nitro ben- zoate	3 5-Di nitro- benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
435	4-Amino-2,5-dinitrophenol	166-7, al										N-Acetyl, 144-5, Me eth, 153, bz - lgr, red, Et eth,
436	4-Amino-2,6-dinitro-3- methylphenol (4-Amino- 2,6-dinitro-m-cresol)	167, red, 50% al										N-Acetyl, 231 d, ac a, Et eth, 96 7, Hydro- chloride, 200 d, dil, HCl
437	2-Benzamidophenol (2- Hydroxybenzanılıde	167 d							109- 10, al	134 40, al		Me eth, 60
439	2,3,4-Trichloro-1-naphthol	168, lgr							ļ t	123-4		
440	2-Hydroxyphenanthrene (2-Phenanthrol)	168, al						İ		142-3	139–40,	Et eth, 112, al,
441	1,5-Di-(2-hydroxyphenyl)- 1,4-pentadiene-3-one	168								di 128, al	al 135, al	Picrate, 156, red Di-Me eth, 125, al, Di-Et eth, 89, al
442	3,5-Diaminophenol	168-70	1									3,5-Diacetyl, 195
443	4-Acetamidophenol (4 - Hydroxyacetamilde)	169								150-1		
444	2-Amino-4,6-dinitrophenol	169, dk					j	]			]	N-Acetyl, 201, N-
	(Picramic acid)	red, al			·							Benzoyl, 230, 220, N-p-Toluene- sulfonyl, 191
445	4-Amino-2-chloro-5-nitro- phenol	169 5 d										N-Acetyl, 166, yel, Et eth, 1285, or
446	3,3'-Dihydroxybenzo-	170								89-90	101-2	Et etii , 128 3, 01
447	phenone 1,4-Dihydroxy-2-methyl-	α 170,								di 113,	181	
	naphthalene (2-Methyl- 1,4-naphthohydro-	β 60, ac a							,	al al		
448	quinone) 4-Amino-2,6-dinitrophenol (Isopicramic acid)	170, br , w										N-Acetyl, 182, N- Benzoyl, 263, 250, Me eth, 212, Et
449	Benzeneazoresorcinol (2,4-Dihydroxyazo- benzene)	170, dk red								di 104,		eth, 172 D <sub>1</sub> -Me eth, 92, red, al, D <sub>1</sub> -Et eth, 70
450	3,4-Diaminophenol	170 2, 167 8, unstable								red, al		yel -red, al N,N'-Diacetyl, 205-7, 3,4-Di- benzoyl, 203 5, 1,3,4-Tribenzoyl, 225, Et eth, 71 2
451	5-Nitro-1-naphthol	171, dk yel -red,								114, w - al	109, me al	b p 294-6 Me eth, 96-7, yel pet eth
452	<b>Hydroquinone</b> (1,4-D1- hydroxybenzene)	w 171, 172	286	dt 224, 205 7		dı 258, al	di 317	dı 186	mono 98-9, bz, di 159, 25% al	di 123, w	di 199, 204 (cor), tol	Aryloxyacetic acid, 250, 2,4-Dinitro- phenyl ether, 243-6, N,N-Di- phenylurethane, 250
$\bot$									aı			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	Phenyl ure- thane	α Naph- thyl ure- thane	p-Nitro- ben- zoate	3 5-Di nitro benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
453	2-Azophenol (2,2'- Dihydroxyazobenzene)	172, yel , bz								di 150, or -red		Di-Me eth, 153, or, Di-Et eth, 131, red
454	2,3,4-Trihydroxyaceto- phenone (Gallaceto- phenone)	173 192 0- 2 5								2,4-di 107-8, 3,4-di 78-81, tri 85		Semicarbazone, 225 d , Oxime, 162-3, Picrate, 133
455	3,5-Dinitrosalicylic acid	173-4 (anh )								,,, ,,	163	Amide, 181, Ani- lide, 180 (subl.), 194
456	2-Aminophenol (2- Hydroxyanılıne)	174									175	N-Acetyl, 209, 201, N-Benzenesul- fonyl, 141, N-p- Toluenesulfonyl, 146
457	3-Benzamidophenol (3-Hy-droxybenzamilide)	174, tol									153	Et eth , 103
458	4-Amino-2-methylphenol (4-Amino o-cresol)	175, bz							109- 10, bz - Igr			N-Acetyl, 179, O,N-Dibenzoyl, 194, ac a, Me eth, 59 0-9 5, 92-3, aq al
459	1,6,7-Trihydroxynaphtha- lene (1,6,7-Naphthalene- triol)	175								<i>tri</i> 143 4		
460	4-Nitrocatechol	176, yel , w					i			dı 98	dı 156, al	Di-Me eth, 96, w - al, Di-Et eth, 73 5, pa yel
461	1,4-Dihydroxynaphthalene (1,4-Naphthalenediol, 1,4-Naphthohydro- quinone)	176, 192								di 128 30, al	<i>di</i> 169, ac a	Me eth, 131, D1- Me eth, 85, CS <sub>2</sub>
462	1,7-Dihydroxynaphthalene (1,7-Naphthalenediol)	178, bz		203 4		182-3				di 108, bz	dı 101 5, 113-5	D1-Et eth, 67
463	1,2-Dihydroxyphenan- threne (1,2-Phenanthrene- diol)	178, w -al					i			dı 147, me al		Di-Me eth, 100 2, lgr
464	4-Amino-6-isopropyl-3- methylphenol (4-Amino- 6-isopropyl-m-cresol)	178-9, bz										N-Benzoyl, 178-9, O,N-Dibenzoyl, 166-7, aq al, Hy- drochloride, 255
465	1,8,9-Trihydroxyanthra- cene (1,8,9-Anthracene-	178 80, 176 7								<i>trı</i> 209 10		
466	triol, Anthralin) 4-Amino-3-methylphenol (4-Amino-m-cresol)	179, 50% al									92, pet eth	N-Acetyl, 138, Hydrochloride, 215,
467	2,5-Dihydroxyphenan- threne (2,5-Phenanthrene-	180, xyl								<i>dı</i> 144, w-ac		Me eth, 29-30 Di-Me eth, 117, ac a
468	diol) 9,10-Dihydroxyanthracene (9,10-Anthradiol)	180, yel								a di 260, ac a	dı 292, yel xyl - chl	Di-Me eth, 202, bz, Di-Et eth, 148, bl fluor, al

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	P Toluenc sul- fonate	Acetate	Benzoate	Miscellaneous
469	1,2,5,8-Tetrahydroxy- naphthalene (1,2,5,8-	180 d								tetra 202		
470	Naphthalenetetrol) 4-Hydroxy-3-iodo-5- methoxybenzaldehyde (5- lodovanilin)	180								105-6	135 5- 6 5	Oxime, 178 9 Semicarbazone, 187 8 d
471 472	6-Nitro-1-naphthol	181 2 181 2, chl								121		N-Acetyl, 178 80 N-Benzyl, 104 5, Me eth , 43, pet
473	2-Amino-4-nitroresorcinol	182, br , aq al										N-Acetyl, 213, yel
474	3-Azoxyphenol (3,3'-Di- hydroxyazoxybenzene)	183								<i>dı</i> 102, 50% al	dı 75, ac a	Di-Me eth, 49 50,
475	N-Benzylidene-4-amino- phenol	183			:					92	144	Me eth, 62, Et eth, 76 (71), Hy- drochloride, 167-
476	4-Aminophenol (4- Hydroxyanılıne)	184 (subl )					178 5 (сог)			168		O,N-Diacetyl, 150, 2,4-Dinitro- benzoyl, 204 5 (cor), N-p-Tol- uenesulfonyl, 253
477	1,9-Dihydroxyphenan- threne (1,9-Phenanthrene- diol)	184 5, bz				!				<i>di</i> 154- 5, w - al		9-Me eth, 131 2, bz-pet eth Di- Me eth, 113 4, me al
478	4,6-Diacetylresorcinol (Resodiacetophenone)	185, al								dı 120	mono 214-5, di 118	Di-Me eth , 171 5, Dioxime, 242, Phenylhydrazone, 233
479 480	4-Amino-2-naphthol 7-Hydroxy-4-methyl- coumarin (4-Methyl- umbelliferone)	185 185 6, al		155–6		143			137	150, al	159-60, al	O,N-Dibenzoyl, 309 Me eth, 159, m- Nitrobenzoate, 210-11, Picrate, 108
481	3-Amino-4-nitrophenol	185–6, or , <b>w</b>										N-Benzoyl, 166, Me eth, 131, Et eth, 105-6
482	1,2,6-Trihydroxynaphtha- lene (1,2,6-Naphthalene- triol)	188	1							tri 262		
483	α,2,4-Trihydroxyaceto- phenone (ω-Hydroxy- resacetophenone)	189								tr. 129	α-mono 200	α-Me eth, 136, p-Nitrophenylhy- drazone, 205 d, Oxime, 105-7
484	2,7-Dihydroxynaphthalene (2,7-Naphthalenediol)	190, 185–6, w							150, chl	mono 171-2, me al, di 136, w	mono 199, me al, di 139, al	Aryloxyacetic acid, 149, N,N-Di- phenylurethane, 176, Me eth, 117 Di-Me eth, 139, Di-Et eth, 104, al
485	1,4,5,8-Tetrahydroxy- naphthalene (1,4,5,8- Naphthalenetetrol)	190								tetra 277 9		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	Phenyl ure thane	α Naph thyl ure thane	p-Nitro ben zoate	3 5 Di nitro benzoate	Bromo derwative	p Toluene sul fonate	Acetate	Benzoate	Miscellaneous
486	1,5-Diacetyl-2,3,4-tri- hydroxybenzene (4,6- Diacetylpyrogallol Gallodiacetophenone)	190 l, w								mono 207 9	tri 189	Tri-Me eth , 73-4
487	3,9-Dihydroxyacridine	190 2 lt br → dk ın aır al										9-Me -3-Et eth, 144, yel, w In al → grn fluor
488	Pentachlorophenol	190 2				:			145	149-50	164-5, 159	Aryloxyacetic acid,
489	5-Amino-2-naphthol	191										O,N-Diacetyl, 187, O,N-Dibenzoyl, 223
	1,4-Dihydroxynaphthalene (1,4-Naphthalenediol)	192								di 128- 30	dı 169	
491	5-Amino-1-naphthol	192						ŀ		1		O,N-Dibenzoyl, 276
492	Tetrabromocatechol	192-3								dı 215-6	di 197-8, bz - Igr	Me eth, 162-3, D1- Me eth, 151-2, 118-20
493		193, al							98	36 8	230-1, ac a	Methiodide, 236 d , Picrate, 235 6
494	3-Methyl-2,4,5,6-tetra- bromophenol (2,4,5,6- Tetrabromo-m-cresol)	194, ac a								165 6	153-4	Me eth , 145 6, al , Et eth , 108, eth
495	1,5-Dichloro-4,8-dihy- droxynaphthalene	194, ac a								4-mono 148- 60, ac a di	4-mono 157-8, ac a, di	
496	1,6-Dinitro-2-naphthol	195 d							181	154, 143, acet	179, acet	Me eth , 204, 198, Et eth , 144, yel , Alc NH <sub>3</sub> at 160° → 1,6-di- ntro-2-naphthyl- amine, 248,
												Oxid → 4-nitro-
497	5,6-Dihydroxyace- naphthene (5,6-Acenaph- thenediol)	196-9, bz							:	<i>dı</i> 194–5		phthalic acid, 165
498	1,2,7-Trihydroxynaphtha- lene (1,2,7-Naphthalene-	197								181-2		
499	triol) 4-Methyl-2,3,5,6-tetra- bromophenol (2,3,5,6-	199								156		
	Tetrabromo-p-cresol)					- 1			l			
	2-Hydroxyquinoline 2-Amino-4-methyl-5-nitro- phenol (2-Amino-5-nitro-	199 199-200 d							ļ			2-Ph eth, 69 N-Acetyl, 242, ac a, Me eth, 132,
502	p-cresol) 6-Amino-1-naphthol	199 5										yel O,N-Diacetyl, 130, N-Benzoyl, 203, O,N-Dibenzoyl,
503	Hexahydroxybenzene	200 d								hexa 203	<i>hexa</i> 313	230

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

#### TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p Toluene sul- fonate	Acctate	Benzoate	Miscellaneous
504	Methylenedi-2-naphthol (2,2'-Dihydroxv-1,1'- dinaphthylmethane)	200, ac a								di 214, al		Di-Me eth , 144-7, al , Picrate, 178 9, red-br
505	3-Hydroxybenzoic acid	200								131		Aryloxyacetic acid, 206, Amide, 170, p-Bromophenacyl ester, 176
506	Methyl gallate (Methyl 3,4,5-trihydroxyben-zoate)	200-1								tri 120, 120 2, al	tri 139, al	
507 508	3-Hydroxyquinoline 7-Amino-2-naphthol	200-1, bz 201, 208							90		177	Picrate, 240 5 N-Acetyl, 232, O,N-Diacetyl, 156, N-Benzoyl, 243-6, O,N-Dibenzoyl, 181
509	<b>4-Amino-3-methyl-2-nitro- phenol</b> (4-Amino-2-nitro- <i>m</i> -cresol)	201, al										O,N-Diacetyl, 127 8
511	2-Acetamidophenol (2-Hy- droxyacetanılıde)	201 3, 209, aq al	1					]		122	140	O,N-Diacetyl, 77
512	2-Acetylhydroquinone (2,5-Dihydroxyaceto- phenone)	202								dı 68	di 113	p-Nitrophenylhy- drazone, 215-6, Oxime, 149-50
513	2,8-Dihydroxyphenan- threne (2,8-Phenan- threnediol)	202, w -al								<i>di</i> 125, al		
514	4-Hydroxy-4'-nitro- biphenyl	203, 200-1							159, bz	138 9, lgr	208- 10, ac a	Me eth , 111, yel., al , 3,5-Dinitro deriv , 197-8
515	3,5-Dimethoxy-4-hydroxy- benzoic acid	205	1						<u> </u> 	191	229-32	:
516	4-Hydroxycoumarin (Benzotetronic acid)	206, 232 3								103		Me eth , 124, w
517	2,3,5-Trihydroxyaceto- phenone	206-7, yel, ac a			<u> </u>					tri 106-7, lgr	<i>tri</i> 106-7	p-Nitrophenylhy- drazone, 241-2 d , w-al
518	2,4,5-Trihydroxyaceto- phenone	206-7, red								2,4-di 165-6, bz		
519	6-Chloro-3-hydroxy-4- methylbenzoic acid	206-8									146	Amide, 239-40, Anilide, 222
520	8-Amino-2-naphthol	207 d										O,N-Diacetyl, 178, O,N-Dibenzoyl, 208
521	3-Azophenol (3,3'-D1- hydroxyazobenzene)	207, yel								dt 144, yel, al	di 188, w-al	D1-Me eth, 73-4, D1-Et eth, 91, yel
522	2-Amino-5-nitrophenol	207-8, or , 201-2, w							188, yel, al			N-Acetyl, 271-2, O,N-Diacetyl, 187, Me eth, 139
523	2-Methyl-3,4,5,6-tetra- bromophenol (3,4,5,6- Tetrabromo-o-cresol)	208								154		
524	2,6-Dichloro-3,4,5-tri- bromophenol	209									202	Me eth , 143-4

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	Phenyl ure thane	α Naph- thyl ure thane	p Nitro ben zoate	3 5-Di nitro benzoate	Bromo derivative	p- Toluene sul fonate	Acetate	Benzoate	Miscellaneous
525	4-Hydroxy-3-methoxy- benzoic acid (Vanillic acid)	210 (subl )				140 1 d				110, w	178, aq al	Hydrazide, 207, Phenylhydrazide,
526	4,4'-Dihydroxybenzo- phenone	210									156, 152	Me eth, 151-2, Di- Me eth, 146, 2,4- Dinitrophenylhy-
527	cis-1,2-Dihydroxyace- naphthene (cis-Acenaph- thylene glycol)	212 3, w								mono 122-3, al, di 130, me al	77	drazone, 190-2
528	4-Hydroxy-4'-nitroazo- benzene	212 3 219 0-9 5					i		<b>,</b>	147, or	195, or	Me eth, 157 5 8 0
	6-Amino-2-naphthol 2,4-Dihydroxybenzoic acid	213 d 213, 216 d										O,N-Diacetyl, 220 Amide, 222, Ani- lide, 126-7, p- Nitrophenyl ester, 189
531	Methylphloroglucinol (2,4,6-Trihydroxy- toluene)	214-6, et ac								tri 76, lgr		2-Me eth, 91 (+1H <sub>2</sub> O), 117 9 (anh), 4-Me eth, 124, Tri-Me eth, 10 13, b p 140-2 <sup>18</sup>
532	4-Hydroxybenzoic acid	215, 210								187	221-3	Aryloxyacetic acid, 278, Anilide, 198, p-Toluidide, 204
533	4,6-Dinitroresorcinol	215, yel				dı 178			mono 135	di 139	di 343-4	Me eth , 113, Di- Me eth , 157, Et eth , 77, Di-Et eth , 133
534	4-Chloro-2,3,5,6-tetra- bromophenol	215		    -			!				203	Me eth , 161
	(2,6-Naphthalenediol)	215, 218	,	<u> </u>				<u> </u>	]	di 175	di 215	D1-Me eth , 50, bz , D1-Et eth , 162, al
536	1,2,4,5-Tetrahydroxy- benzene	215-20							ļ	<i>tetra</i> 226-7		2-Me eth, triacetyl, 142, Tetra-Me eth, 103
537	4-Azophenol (4,4'-Dı- hydroxyazobenzene)	α 216, grn (anh), β 216, dk red (anh)								di 198-9, yel, ac a	di 210 5 1 5, 249- 51, red- yel,	Di-Me eth , 160 5 2 5, me al , Di-Et eth , 157-9, yel , al , 160
538	2-Amino-3-nitrophenol	216 7, red		į					136		bz	N-Acetyl, 172, Me eth, 75-6
539	4-Benzamidophenol (4-Hy-droxybenzanılıde)	216 7, 227								171	235	Me eth, 153-4, al, Et eth, 173, aq al, Benzyl eth, 226-7
540	2,5-Dimethylhydro- quinone (Hydro- phlorone)	217							,	mono 117, di 135	mono 162-3, pet eth, di 159, me al	Me eth , 90, lgr

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, *C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro ben- zoate	3,5-Di- nitro benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
541	Phloroglucinol (1,3,5 Trihydroxybenzene)	217 9, rapid htng, 200 9, slow htng		tri 190 1		283	tri 162	tri 151		tri 104 6, al	tri 173 4, al	Monobenzenesul- fonate, 163 4 (anh) Monoben- zenesulfonate, di acetate, 95 6, bz Dibenzenesul- fonate, 120-1, bz, Dibenzenesul- fonate monoacetate. 81 me al
542	2-Amino-3,5-dinitrophenol	218, yel , al							186			O,N-Di p-Toluene sulfonyl, 188 N Acetyl, 171 Me eth, 181
543	2,2'-Dihydroxy-1,1'- binaphthyl	218								di 109, al	mono 204, di 160	Dipicrate, 175 6, Di-Me eth , 190, Di-Et eth , 90
544	7-Hydroxybenzo [a]pyrene	218 9, yel								194 5, yel	191 2, yel	Me eth, 183 4, pyr p-Nitro- benzyłeth, 252-3
545	Acetylphloroglucinol (2,4, 6-Trihydroxyaceto phenone, Phloraceto- phenone)	219, w , 222		:						tri 103	2-mono 168, 4 mono 210- 11, tri 117-8	2-Me eth 205 7 4-Me eth , 139 40, Tri-Me eth , 103 Tri-Et eth , 75, aq
546	1,1'-Dihydroxy-2,2'-	220								dı 169	117 6	D1-Me eth , 122,
547	binaphthyl 3,5-Dihydroxypyrene	220 d , ac								dı 155		lgr Dı-Me eth , 177-8
548	3,6-Dihydroxyphenan- threne (3,6-Phenan- threnediol)	a 221, w -al								<i>dı</i> 124 5, al		3-Me eth , 135 6 w -me al Di-Me eth , 104-5, w - me al
549	2,3-Dimethylhydro- quinone (3,6-Dthy- droxy-o-xylene)	221, sl d , w								mono 174 5, acet - pet eth , di 182, acet - pet		Di-Et eth , 68 9
550	3-Hydroxy-2-naphthoic acid	222								eth 184-6		Amide, 218, Ani- lide, 244 p-Tolui
551	methylphenol (4-Amino-	223-5 d										dide, 222 O,N-Diacetyl, 162 O,N-Dibenzoyl,
552	6-chloro-m-cresol) 4-Azoxyphenol (4,4'-D1-hydroxyazoxybenzene)	224 d								di 163, or,al	mono 200, al, 212, bz, di 187-90	220 Di-Me eth, 118-9 yel, Di-Et eth, 137-8

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5-Di- nitro- benzoate	Bromo derivative	p Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
553	5-Hydroxyquinoline	224							85			Hydrochloride, 240, Methiodide, 224, Picrate, 187
554	2-Amino-4-chloro-5- nitrophenol	225 d , yel										N-Acetyl 193 Me eth, 132
555	1,2,3,4-Tetrahydroxy- naphthalene (1,2,3,4- Naphthalenetetrol)	225								tetra 220		
556	1,8-Dihydroxyanthracene (1,8-Anthracenediol, Chrysazol)	225, yel , al -w								di 184, et ac	•	Di-Me eth , 198, al , Di-Et eth , 139, al
557	· '.	228, yel										O,O,N-Triacetyl, 207, ac a
558 559	5-Hydroxycoumarin 2-Hydroxy-5-nitro-benzoic acid	229 229 30								88 9, 84		Me eth , 85 7 Amide, 225, Ani- lide, 224
560	Pentabromophenol	229 5, 225 6								197, 171		Me eth, 173 4, Et eth, 136
561	2,6-Dihydroxyphenan- threne (2,6-Phenanthrene- diol)	234, w -al								dı 122-3, al	dı 252 3	Di-Me eth , 87, me al
562	3-Amino-2-naphthol	235										O,N-Diacetyl, 188, O,N-Dibenzoyl, 184
563	5-Hydroxy-1-naphthoic acid	235								202	241	
564	2,3-Dihydroxyacridine (2,3-Acridinediol)	235 d										Dı-Me eth , 107, yel -wh , al
565	Tetrachlorohydroquinone	236 7								dı 245	dı 233	
566	7-Hydroxyquinoline	238-40, al, (br at 200)							116		88-9, al	Methiodide, 251 d , al , Picrate, 244-5
567	1,7-Dihydroxyanthrone (Euxanthone)	240								7-mono 160, al, di 185, bz	dı 221 2, 214	7-Me eth , 130-5
568	1,6-Dihydroxypyrene (1,6- Pyrenediol)	240 d , sinters at 175								100,00		Sol red with grn fluor In alkali red soln with bl fluor, Zn dust → pyrene, 149-50
569	4-Amino-2,5-dimethyl- phenol	242 d , al										N-Acetyl, 177 9, al, Et eth, 69 5
570	3,8-Dihydroxyphenan- threne (3,8-Phenanthrene- diol)	247, lt red, w -al					:			dı 184, al		Di-Me eth , 117, me al
571	3-Hydroxy-1-naphthoic acid	248								169 70	222-3	Amide, 209-11, Anilide, 112-3
572	2,5-Dihydroxypyridine (2,5-Pyridinediol)	248								5-mono 156		Hydrochloride, 106 (hyd), 154 (anh)
573	1,4-Dihydroxyisoquino- line (1,4-Isoquinoline-	>250, ac a turns red								4-mono 207-8		4-Me eth, 171, acet -pet eth
	diol)	at 200								,	,	
574	2,3-Dihydroxyquinoline (3-Hydroxycarbostyril, 2 3-Quinolinediol)	257 8, >300								3-mono 211	3-mono 286 7, di 45	
										į	6, pet eth	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Phenyl ure- thane	α-Naph- thyl- ure- thane	p-Nitro- ben- zoate	3,5 Di- nitro- benzoate	Bromo derivative	p- Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
575	1,5-Dihydroxynaphthalene (1,5-Naphthalenediol)	265, 258								<i>dı</i> 159- 61, dıl al	di 235, 242, pyr	Di-Me eth, 183 4 Di-Et eth, 130, w-al, 2 Naph- thylamine add comp, 229 5
576	2,7-Dihydroxyphenan- threne (2,7-Phenanthrene- diol)	265, w -al								dı 181 5, al		Di-Me eth , 169- 70, me al
577	Phenolphthalein	265 (cor ), 261		di 135, bz						dı 143, al	dt 169, bz - lgr	
578	1,5-Dihydroxyanthracene (Rufol, 1,5-Anthracene- diol)	265 d , yel								di 198, et ac		Di-Me eth , 224, me al , Di-Et eth 179, al
	4,4'-Biphenol (4,4'-Di- hydroxybiphenyl)	274 5, al							dı 189 90, bz	d <sub>1</sub> 161, d <sub>1</sub> al , 164 (cor)	di 241, ac a	Aryloxyacetic acid 274, Di-Me eth, 173 (subl.), Di-Et eth, 176
580	1-Amino-2-naphthol	276 d										O,N-Diacetyl, 206 O,N-Dibenzoyl, 235
581	2,7-Dihydroxyanthracene (2,7-Anthracenediol)	280-5 d , bz , turns dk at 250								282		Di-Me eth, 216 7 ac a, Di-Et eth 192~3
582	2,3-Dihydroxyanthracene (2,3-Anthracenediol)	282 d , yel								dı 175		Di-Me eth , 204, a
83	<b>4,4'-Dihydroxystilbene</b> (4,4'-Stilbenediol)	284, ac a								dı 213		D1-Me eth , 214-5 D1-Et eth , 208
84	3,5'-Dimethoxy-5,7,4'- trihydroxyflavonol (Syringetin)	288 9, pa yel, ac a								tetra 224-6		4'-Benzyleth, 240]
85	2,7-Dihydroxy-4-methyl- quinoline	290-300, w-al (+1H <sub>2</sub> O), turns br at 280								7-mono 250-4, al	7-mono 288, al	
86	2,6-Dihydroxyanthracene (Flavol 2,6-Anthracene- diol)	295-300 d , al , turns dk at 270							3	<i>dı</i> 260 l, ac a		Di-Me eth , 255-6 ac a , Di-Et eth . 230-1
87	Bi-α-naphthol (4,4'-Dι- hydroxy-1,1'-binaphthyl)	300, 250								di 217		Di-Me eth , 252, Di-Et eth , 211
	2,8-Dihydroxyacridine (2,8-Acridinediol)	>300, turns red at 275										Di-Me eth , 138-9 Di-Et eth , 142 3
89	2,6-Dibromo-1,5-dihy- hydroxynaphthalene	>300, 224 d turns dk at 200								1-mono 273, di 228	dı 262, pyr	1-Acetate, 5-ben- zoate, 164, Di-Me eth, 161, Di-Et eth, 148
90	3,7-Dihydroxyacridine (3,7-Acridinediol)	324, pa yel, w -al										In al sol → grn fluor
91		330, Tri- cl-bz -ph hydraz , turns dk								dı 224, ac a		Di-Me eth , 244, cl-bz

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

#### TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point *C	Boiling point °C	Phenyl ure- thane	α-Naph thyl ure- thane	p Nitro ben zoate	3 5-Di nitro benzoate	Bromo derwative	p- Toluene sul fonate	Acetate	Benzoate	Miscellaneous
592	1,3-Dihydroxyacridone	370								mono 200, yel	mono 295 7	Me eth (1) 203, dk br, (11) 252, yel, DI-Me eth, 286-7 d, Amil, 269 70, Zn dust → acri- dine, 111

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLE VIII

Cleavage to alkyl bromide or alkyl iodide

From the ether with concentrated hydrochloric acid

For directions and examples see Cheronis, p 543, Linstead, pp 46 7, Shriner, p 116, Vogel, p 316

NOTE For directions and examples for preparation of derivatives of alkyl iodides and alkyl bromides formed on cleavage of ethers see explanations and references to Table V, pp 52, 53, 54

Alkyl 3 5-dinitrobenzoate \*

ROR + 
$$\frac{NO_2}{COCl}$$
  $\frac{ZnCl_2}{NO_2}$   $\frac{NO_2}{NO_2}$   $\frac{Alkyl 3 5-dinitrobenzoate}{COCl}$ 

From a symmetrical aliphatic ether with freshly fused zinc chloride and 3,5-dinitrobenzoyl chloride For directions and examples see Cheronis, pp 542, 543, Linstead, p 46, Shriner, p 239, Vogel, p 316, Wild, p 96 H W Underwood, O L Baril and G C Toone, J Amer Chem Soc, 52,4087 (1930)

Bromo derivative

ArOR 
$$\xrightarrow{Br_2}$$
 Ar(OR)Br

Bromoaryl
ether

ArOR  $\xrightarrow{nBr_2}$  Ar(OR)Br<sub>n</sub>

Polybromoaryl
ether

From alkyl aryl or diaryl ether with bromine in glacial acetic acid or chloroform

For directions and examples see Cheronis, p 545, Shriner, p 240

From the aromatic ether with bromine in alcohol, acetic acid, ether, chloroform or petrol ether

See Wild, pp 98-9, 101, H W Underwood, O L Baril and G C Toone, J Amer Chem Soc, 52, 4087 (1930)

Sulfonamide \*

ArOR 
$$\xrightarrow{\text{CISO}_2\text{OH}}$$
 Ar(OR)SO<sub>2</sub>Cl  $\xrightarrow{\text{(NH}_4)_2\text{CO}_3}$  Ar(OR)SO<sub>2</sub>NH<sub>2</sub>

Sulfonyl Sulfonamide chloride

The sulfonyl chloride is prepared from the aromatic ether with chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with ammonium carbonate and/or aqueous ammonia.

For directions and examples see Cheronis, pp 545, 546, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, pp 27, 101, E H Huntress and F H Carten, J Amer Chem Soc, 62, 511, 603 (1940)

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

#### **EXPLANATIONS AND REFERENCES TO TABLE VIII (Continued)**

Picric acid and 1,3,5-trinitrobenzene addition complexes

ArOR + 
$$O_2N$$
  $\longrightarrow$  ArOR  $\cdot O_2N$   $\longrightarrow$  X  $\longrightarrow$  ArOR  $\cdot O_2N$   $\longrightarrow$  X  $\longrightarrow$  NO<sub>2</sub>

Picric acid or 1 3 5-Trinitrobenzene molecular complex

From the aromatic ether with the aromatic polynitro compound in chloroform

For directions and examples see Cheronis, pp 545, 547, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, p 100, O L Baril and G A Megrdichian, J Amer Chem Soc, 58, 1415 (1936), E K Andersen, Acta Chem Scand, 8, 157 (1954)

From the aromatic ether with picric acid in ethanol

See V H Dermer and O C Dermer, J Org Chem, 3, 289 (1938)

NOTE For additional information regarding directions and examples for the derivatization of aromatic ethers (nitration, side-chain oxidation, etc.) see explanations and references to Table IV, pp. 32, 33, 34

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

# TABLE VIII. ORGANIC DERIVATIVES OF ETHERS a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point °C	n 20	D <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1 3 5 Tri- nitro- benzene addition com pound	3 5 Dinitro benzoate	Miscellaneous
1	Ethylene oxide (Epoxyethane)	10 7	-1117	1 36144	0 897134							HBr → Ethylene bromohydrin, bp 149
2 3	Ethyl methyl ether Furan	10 8, 10 31 27	-85 6	1 42157	0 7260° 0 9366							Maleic anhydride → 3,6-Endoxo-Δ <sup>4</sup> - tetrahydrophthalic anhydride, 125d 118d , abs eth
4	Diethyl ether (Ethyl ether)	34 60	-116 3, stab, -123 3,	1 3526	0 71352						93	lodide, b p 72
5	Propylene oxide (1,2- Epoxypropane)	35	unst	1 466	0 830							Heating with dil H <sub>2</sub> SO <sub>4</sub> → d l-propylene glycol, b p
6	Ethyl vinyl ether	35 75	-1158	1 3768	0 7589				:			Dil acid → al + acetaldehyde
7 8	Methyl <i>n-</i> propyl ether Allyl methyl ether	39 46		1 3579	0 735643				β,γ-dι b p 185,			acciancingue
9	Ethyl isopropyl ether	53 4			0 7211 (0 745 <sub>4</sub> )				D <sub>4</sub> º 1 8329			Heating with 1%  H <sub>2</sub> SO <sub>4</sub> (sealed  tube) → al + iso- propyl alcohol
10	tert-Butyl methyl ether	55 2		1 3689	0 7405							Constant boil mixt with w, b p 52 6,
11	2,3-Epoxybutane	cis 58 9 <sup>745</sup> trans 53-4 <sup>741</sup>			cis 0 8226 <sup>25</sup> , trans 0 8010 <sup>25</sup>							with 4% w Normal crude mixt is 65% trans + 35% cis
12	Chloromethyl methyl ether	59		1 3974	1 015	163						
13	α-Butylene oxide (1,2- Epoxybutane)	61-2		1 38517	0 83717							
14	Ethyl <i>n</i> -propyl ether	63 6	<-79	1 36948	0 7386							Constant boil mixt with al, bp 612,
15	2-Methylfuran (Sylvan)	64		1 434	0 913							with 25% al
16	Tetrahydrofuran	65		1 407	0 889						]	
	Allyl ethyl ether	66-7742		1 3881	0 7651				β,γ-dι b p 193-5			Heating with 2% H₂SO₄ → al + allyl alcohol
18	Di-isopropyl ether (Isopropyl ether)	67 5	-60	1 3688	0 726						123, 120-1, CCl <sub>4</sub>	.,

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE VIII. ORGANIC DERIVATIVES OF ETHERS a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n D	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon- amide	Nitro derivative	Bromo derivative	1,3,5- Tri- nitro- benzene addition com pound	3,5- Dinitro benzoate	Miscellaneous
19	n-Butyl methyl ether	70	-115 5	1 3728, 1 3736	0 7455, 0 774							Oxid by alkaline KMnO <sub>4</sub> at 35 40° → ac a + methoxyacetic
20	tert-Butyl ethyl ether	73 1 (cor)		1 3760	0 7404							acid Constant boil mixt with w, b p 65 2, with 6°, w
21 22	Tetrahydrosylvan Chloromethyl ethyl ether	79 80, 83d		1 407 1 40398	0 855 1 014							
23	Ethyl isobutyl ether	81 1 (cor)		1 373925	0 732345							
24	sec-Butyl ethyl ether	81 2 (cor)		1 3802	0 7503							
25	Isopropyl <i>n</i> -propyl ether	83		1 376	0 7370							
26	Ethylene glycol di- methyl ether	84 7		1 37965	0 8665							
27	Dihydropyran	86		1 440	0 923				:		ļ	
28	leri-Amyl methyl ether	86 3		1 3885	0 7703							Constant boil mixt with w, bp 73 8, with 9% w, Constant boil mixt with me al, bp 62 3, with 50% me al
29 30	Tetrahydropyran Di-n-propyl ether (n- Propyl ether)	90 1	-122	1 421 1 38829	0 881 0 74698						74	Constant boil mixt with w, bp 75 4, Constant boil mixt with n-propyl alcohol, bp 85 8
31	n-Butyl ethyl ether	92 3 (cor)	-124	1 3820	0 7505							•
32	2,5-Dimethylfuran	94		1 436321 6	0 88840 1				penta 180, chl			Maleic anhydride → 3,6-Endoxo-3,6-dimethyl-Δ⁴-tetra-hydrophthalic anhydride, 78, eth
33	α-Chloroethyl ethyl ether	98		1 404	0 966							Cili
34		99-100		1 3873	0 761							
35	tert-Amyl ethyl ether	101		1 3912	0 7657							Constant boil mixt with 13% w, b p
36	1,4-Dioxane	101 4	11 8	1 4232	1 03361				65-6			81 2 Iodine derivative, 84 5, Constant boil mixt with 48 mole % dioxane, b p 82 8

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# TABLE VIII. ORGANIC DERIVATIVES OF ETHERS a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n 20°	D <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1 3 5 Tri nitro benzene addition com pound	3 5 Dinitro benzoate	Miscellaneous
37	Ethylene glycol mono- ethyl monomethyl ether (1-Ethoxy-2- methoxyethane)	102		1 38677	0 8529							
38	Cyclopentyl methyl ether	105		1 4206	0 862							
39	$\beta$ -Chloroethyl ethyl ether	107		1 411	0 989							
40	n-Butyl isopropyl ether	108 <sup>738</sup>		1 3889 5461	0 759415		i i					Boil HI → n-butyl rodide + isopropyl rodide
41 42	$\alpha$ -Epichlorohydrin $\alpha$ , $\alpha'$ -Dichloroethyl ether	115 7 116, 114		1 438 1 4183 <sup>24</sup>	1 181 1 138 <sup>12</sup>							logide
43 44	<i>n-</i> Amyl ethyl ether Di- <i>sec-</i> butyl ether	118 121		1 3927 1 3928 <sup>2</sup>	0 762 0 760				b p 90 1 n∯ 1 250		75 5	
45	Cyclopentyl ethyl ether	122		1 423	0 853		i İ	! [	1 230			
46	Di-isobutyl ether (Iso- butyl ether)	123			0 7616¦\$						87, 84 5 5 5	
47	Ethylene glycol mono- methyl mono-n- propyl ether (1- Methoxy 2-n propoxyethane)	124 5		1 39467	0 8472						33	
48 49	n-Hexyl methyl ether 2-Methoxy-1-propanol	126 130 <sup>758</sup>		1 3972	0 772						97	α-Naphthylure- thane, 60
50	Cyclohexyl methyl ether	134		1 435	0 875							
51	Ethylene glycol mono- ethyl ether ("Cello- solve", 2-Ethoxy- ethanol)	134 8, 135 1		1 40797	0 9297 0 9311						75	Miscible with w, with all and with eth, Diphenylurethane, 43, Xanthate, 202 5 (cor), acet abs eth
52	3-Ethoxy-2-methyl-2- butanol	141								:		Phenylurethane, 226
	n-Hexyl ethyl ether	142		1 4008	0 772	}						
-	Di-n-butyl ether (Butyl ether)	142 4, 144	-98	1 3989	0 76829						62 3, 64	
	Cyclohexyl ethyl ether Anisole (Methoxyben- zene, Methyl phenyl ether)	149 153 8, 155 (43 <sup>10</sup> )	-37 5	1 435 1 52211	0 864 0 99393	79 81, unst in air	113, 110 1, al	2,4-di 86 9, al, 95 5	2,4-di 61, al		87	
57	3-Methoxy-2-methyl-	155		1 414027				733			64	
58	1-propanol Diethylene glycol dimethyl ether	162 0	-75	1 4099	0 944020							

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# TABLE VIII. ORGANIC DERIVATIVES OF ETHERS a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n 20	D <sub>i</sub> o	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3 5 Tri- nitro benzene addition com pound	3,5- Dinitro- benzoate	Miscellaneous
59	Furfuryl alcohol (2- Furancarbinol)	170		1 4868	1 1351						80-1, pyr	p-Nitrobenzoate, 76, N-Phenyl- urethane, 45
60	Ethylene glycol mono- n-butyl ether (n-Butyl "cellosolve")	171743		1 4177	0 9188				172		oıl	3-Nitrophthalate,
61	Benzyl methyl ether	170-1		1 5008	0 9649	115 6						
62	2-Methoxytoluene (2- Methyl anisole, Methyl 2-tolyl ether, 2-Cresyl methyl ether)	(cor) 171		1 505	0 9853	116, 113 4, pa yel	137, al	3,5-di 69, pa yel, me al	5-mono 63-4, al			Oxid → o-Methoxybenzoic acid,
63 64	· ·	172 172 5	-33	1 5080, 1 5074 1 409	0 9666 0 778	92	150	<i>p-mono</i> 58			60 1	Constant boil mixt
65	amyl ether) 4-Methoxytoluene (4-Methylanisole, Methyl 4-tolyl ether, 4-Cresyl methyl ether)	173, 176		1 512	0 970	88-9, yel -or	182, al					with w, b p 97 2  Oxid → p-Anisic acid, 184-6, 184, w
66	· ·	173, 177 (eor)		1 513	0 972	113 4. yel -or	129 30, al	2-mono 54-5, pet eth, 2,4,6- tri 92, al				Oxid → m-Meth- oxybenzoic acid, 110
67	Tetrahydrofurfuryl alcohol	117		1 45167	1 0544			ai			83-4	p-Nitrobenzoate, 46-8, N-Phenyl- urethane, 61, pet eth
68	Phenyl isopropyl ether	178		1 4992	0 975							conc H <sub>2</sub> SO <sub>4</sub> + ac a → o-Isopro- pylphenol, b p 213-4, m p 130
69	β,β'-Dichloroethyl	178		1 4568	1 220							213-4, iii p 130
70	ether 2-Ethoxytoluene (2- Cresyl ethyl ether, Ethyl 2-tolyl ether)	184		1 505	0 953	117 5 8 5, pa yel	148-9, al	dı 51				Oxid → o-Ethoxy- benzoic acid, 25, 19 0- 5, well dried
71	Benzyl ethyl ether (Homophenetole)	184-6 (cor)		1 4958	0 9478	yei			•			Refluxed in bz + $P_2O_5 \rightarrow Ethylene$ + Diphenyl-
72	Di-n-amyl ether (n- Amyl ether)	187 5	-69 3	1 416	0 78298						42 3	methane, 25 1
73		188		1 411	0 906					ł		
74	Phenyl n-propyl ether (n-Propoxybenzene)	188, 189 3 (cor)		1 5014, 1 5011	0 949428		116 7, al					

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point, °C	n 20	D <sub>4</sub> 20	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3 5- Tri- nitro- benzene addition com- pound	3,5- Dinitro- benzoate	Miscellaneous
75	4-Ethoxytoluene (4- Cresyl ethyl ether Ethyl 4-tolyl ether)	190 5		1 505	0 949	110 1, or yel	138 0 5, al					Oxid → p-Ethoxy- benzoic acid, 198, 195 0- 5, al
76	3-Ethoxytoluene (3-Cresyl ethyl ether Ethyl 3-tolyl ether)	190 5		1 506	0 949	114 5 or -yel	110 1 al					Oxid → m-Ethoxy- benzoic acid, 137
77	Diethylene glycol monomethyl ether	194		1 4244	1 03520							p-Nitrophenyl- urethane, 73 5
78	3-Chloroanisole	194	]	į		1	131	]		]	1	
79 80	2-Chloroanisole Diethylene glycol monoethyl ether	195 196		1 5433 <sup>25</sup> 1 4298	1 1865 <sup>25</sup> 1 023 <sup>20</sup>			95			oıl	p-Nitrophenyl- urethane, 66
81	4-Chloroanisole	200			1 1851128	ļ	151	2-mono 95				
82	n-Butyl phenyl ether (n-Butoxybenzene)	206		1 5049		110-2, pa yel chl	103 4, al					
83	2-Chlorophenetole	208	17		}	1	133	82		}	1	
	2-Bromoanisole	210					140	106				
[	Benzyl isobutyl ether	210 2 (cor)		1 4826	0 9233							
	p-Bromoanisole	215, 216			1 4944		148	88				
	Methyl thymyl ether	216 216	47	1 4233	0 9544			tri 92				
00	Triethylene glycol dimethyl ether	216	-47	1 4233	0 987128		}	]				
89	1,3-Dimethoxybenzene (Resorcinol dimethyl ether)	217 (cor)	-58, -52	1 4233	1 055225	56 8, or - yel, unst in air	166-7, al	2,4-di 72, pa yel, al, 4,6-di 157 al, 2,4,6- tri 123-4,	4,6- <i>di</i> 140, al			
- 1								pa pa				
								red, al			}	
90	2-Bromophenetole	218					135	98				
91	Benzyl n-butyl ether	219-21		1 4833	0 9227						[	!
92	Creosol (4-Methyl- catechol 2-methyl	(cor ) 221	5 5	1 535325	1 091945	112, yel						
93	ether) n-Butyl 2-tolyl ether (2-Butoxytoluene)	223			0 94378		95-6, al					
94	2-Methoxyaniline (2-Anisidine)	225	5		1 097815							N-Formyl, 83 5, N-Acetyl, 87-8
95	Di-n-hexyl ether (n- Hexyl ether)	228-9781			0 7936						54 5-5 5	
96		233	11	1 5383	1 100	104 0 5 5, or -red			tri 108, penta 169-	51		
97	4-Bromophenetole	233, 229	12				145	47	70, bz			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

	<del>,</del>											
No	Name	Boiling point °C	Melting point °C	u D	D;	Picrate	Sulfon amide	Nitro derivative	<b>B</b> romo derivative	I 3 5 Tri nitro benzene addition com pound	3 5 Dinitro benzoate	Miscellaneous
98		235	12 4			109	184		tri 69			
99	ether Eugenol methyl ether (4-Allyl-1,2-d1- methoxybenzene)	244		1 5360	1 0336	114 5, red- br, chl	7		tri 78, abs al			
	2-lodophenetole trans(β)-lsosafrole (1,2-Methylene- dioxy-4-propylben- zene)	246 248	6 8	1 5782	1 800 1 122	84 74 5, dk red, chl			tri 110 di 52-3, eth, tri 109 10, pet eth	85 6, brt scar	•	
102	3-Methoxyaniline (3-Anisidine)	251				169d , yel			•			N-Formyl, 57, N-Acetyl, 81, N-p-Toluenesulfonyl, 68
103	Di-n-heptyl ether (n-Heptyl ether)	263, 260		1 427	0 805620						47	
104	Isoeugenol methyl ether	264	16-7	1 5692	1 0528	42 5, dk red, chl			di 101 0 5, abs	69-70, brt scar		Oxid → Veratric acid, 181
105	Tetraethylene glycol dimethyl ether	266, 275		1 432	1 009				0			
106	Methyl 1-naphthyl ether (1-Methoxy- naphthalene)	271 (cor)	< -10	1 694025	1 09159	129 5 30 5 yel - or , chl	156 7, al	2-mono 80, 4 mono 85, yel, al	4-mono b p 181-2, 5- mono 67 5 8 0, x- mono 46, al , 2,4-di 5,4 5, al	139 40, 137 8, yel		
107	2-Nitroanisole	277	10	1 562	1 254				aı			Reduct → o- anisidine, b p 225
108	Ethyl 1-naphthyl ether (1-Ethoxynaph- thalene)	280 5 (cor)	5 5	.1 5973 <sup>25</sup>	1 074	118 5 9 0 (cor)	164-5, al	2-mono 84, 4- mono 116-7,	4- <i>mono</i> 48, al	125 5, yel		, <b></b> -
109	Dibenzyl ether (Benzyl ether)	290 300d	3 6		1 0428	77 8, or - yel , chl		aı	<i>dı</i> 107- 8, al		112	
110	Isoamyl 1-naphthyl ether	317 5 (cor)	< -10	1 5704914 2	1 0068914 2							

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	n 20 D	D <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	<b>B</b> romo derivative	1,3,5- Tri nitro- benzene addition com- pound	3,5 Dinitro ben zoate	Miscellaneous
1	4-Chlorophenetole (1- Chloro-4-ethoxybenzene)	21	212	1 522719	1 123120		134		2,6 di 54			
2	Veratrole (1,2-Dimethoxy- benzene)	22 5	207, 205	1 528721	1 080	56 7, red	135 6, al	95	4,5-di 92-3			
3	Anethole (1-Methoxy-4- propenylbenzene)	22 5, al	235	1 558	0 989 <sup>2*</sup>	69 70d , or -red, al			di 67, eth, 65, 62 4, tri 108, pet eth			
4	4-Methoxybenzyl alcohol (Anisyl alcohol)	24	151 <sup>27</sup> , 138 <sup>14</sup>						per em			Phenylurethane, 93 p-Nitroben- zoate, 94
5	n-Amyl 2-naphthyl ether	24 5	327 5 (cor)	1 558730		66 5 7 0, or , h al	159	dı 135	di 58			2040, 74
6	<b>4-Iodophenetole</b> (1-Ethoxy-4-Iodobenzene)	27	252			"		96				
7	Diphenyl ether (Phenyl ether)	28	259	1 582624	1 073	110	<i>di</i> 159, al	4,4'-di 144 4, al, 2,4,2',4'- tetra 195 7, pa yel, ac a	4,4'-di 54 5, al			
8	Isoamyl 2-naphthyl ether	28 0 5	321 0 (cor)			93 5-4 0, al		ac a				
9	2-Methoxyphenol (Guaia- col, Catechol mono- methyl ether)	28 2	205	1 5441	1 1287 vac	86 7			4,5,6- <i>tri</i> 116, al		141 2 (cor ),	
10		29, pet eth	274					5-mono 95 6, pa yel, me al				
12	Isobutyl 2-naphthyl ether	32 33 33, 28- 30	304 190-51			84 5			56			
14	2-Ethoxybiphenyl (2-Bi- phenyl ethyl ether)	34	1326									
15	sec-Butyl 2-naphthyl ether	34	298 5 (cor)			86						
	3-Ethoxybiphenyl (3-Bi- phenyl ethyl ether)	35	158*							i		
17	3-Nitrophenetole	35	284									Reduct → m- Phenetidine,
18	n-Butyl 2-naphthyl ether	35 5	309 (cor.)			67			1			(Picrate, 158)
19	Ethyl 2-naphthyl ether (Neonerolin)	36, 37	(cor ) 282 (cor )	1 593247	1 064	101	161-3, al		1-mono 66, pet eth, 1,6- di 94,			
20	3-Aminodiphenyl ether	37, lgr	315						pet eth			N-Hydrochloride 141, 139, N- Acetyl, 83, Igr

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	n <sup>20</sup>	D{°	Picrate	Sulfon- amide	Nitro- derivative	Bromo derivative	1 3,5- Tri nitro benzene addition com- pound	3 5 Dinitro ben zoate	Miscellaneous
21	3-Nitroanisole	39	258		1 37318							Reduct → m- Anisidine, (Pic-
22	Isopropyl 2-naphthyl ether	40	285			95						rate, 169d)
23	2-Naphthyl n-propyl ether	40	297	1		81		1				
24	Catechol diethyl ether (1,2- Diethoxybenzene)	43, dıl al	217			69-71, red-br, unst in air	3,4-di 162 3, al	tri 122				
25	bz-Tetrahydro-6-methoxy- quinoline	43	130	1 547 1850								
	2,4,6-Trichlorophenetole	44	246					di 100				
	8-Methoxyquinoline	45	17529			162						
	2-Ammodiphenyl ether	47	17314			70.6		_				Acetate, 81
29	Pyrogallol trimethyl ether (1,2,3-Trimethoxybenzene)	47, dil al	241			78 5- 80 0, yel	2,3,4- tri 123 4	5-mono 106, ac a	mono oil, di oil, 4,5,6-tri 73 4	81, pa yel		
30	4-Iodoanisole	52	139									
31	Phloroglucinol trimethyl	52 3,	255 5						2 mono			
	ether (1,3,5-Trimethoxy- benzene)	al	(cor)	1					96 7, dil al , 2,4- di 129- 30, al , 2, 4,6-tri 145, al			
32	Hydroquinone monomethyl ether	52 5	244754 2						113, 41			
33	4-Nitroanisole	54	274	1 570760	1 23340							Reduct → p-Ani
34	Hydroquinone dimethyl	56,	213			47-8, or -	148, al	2-mono	di 142,	dı		sidine, 57
	ether (1,4-Dimethoxy- benzene)	75% al	(cor)			red, unst in air		72, yel, 2,3-di 177, 2,5- di 202	ac a	86 5, red		
35	4-Methoxyaniline (4-Anisidine)	57	246		1 07145							N-Formyl, 81, N-Acetyl, 130–2, w, N-Benzoyl, 216, 7
36	4-Cyclohexylphenyl methyl ether	59	1164									210 7
	2,4,6-Trichloroanisole	60						dı 95				
38	1,3-Diphenoxypropane (Trimethylene glycol diphenyl ether)	61, al	338-40 (cor)				4,4'-dı 245 55, al					
39	Catechol dibenzyl ether (1,2-Dibenzyloxy-benzene)	63 4, wh, me al				:	,	4- <i>mono</i> 98, pa yel, al				
40	1-Phenyl-2-phenoxy- methanol	64										p-Nitrobenzoate, 84
	α-Glyceryl phenyl ether 2,4,6-Tribromophenetole	70 72	18715					79				

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

_			,				,	<del></del>	<del>,</del>	т		
No	Name	Melting point, *C	Boiling point, °C	n <sup>20</sup>	D <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	I,3,5- Tri- nitro- benzene addition com- pound	3,5- Dinitro- ben- zoate	Miscellaneous
43	Hydroquinone diethyl ether (1,4-Diethoxybenzene)	72						mono 49, yel, 2,3- di 130, yel, al, 2,5-di 176, yel,		86 5		
44	Methyl 2-naphthyl ether (Nerolin)	73 (cor), eth	273			116 5- 7 0, dk yel, 113 0- 3 5	150 1, al	1-mono 128, 1,6,8- tri 215 d	x-mono 62 3, pet eth , 1-mono 83-4, 3-mono 77 8, 6-mono 108	93 5, yel		
	2,4,5-Tribromophenetol 4-Ethoxybiphenyl (4-	73 76, 74	18813					79				
47	Biphenyl ethyl ether)	77 (cor)	20012			85-100						N.
48	2-Phenyl-2-phenoxy-	81				(cor)						p-Nitrobenzoate,
49	ethanol 4-Aminodiphenyl ether	83 5,	18914				}					87 N-Acetyl, 127,
50	Biphenylene oxide (Di- benzofuran)	84, w 86, wh, al	288 (cor)			94		3-mono 181-2, di 245, ac a		96, yel		N-HCl, 122
51	4-Methoxybiphenyl (4- Biphenyl methyl ether, 4- Phenylanisole)	90, 89		-			3-mono 91 2, al, 3,5-di 137-8, yel, al, 3,4'-di 171	3-mono 79, 4'-mono 144, pet , 3,4'-di 134, 3,5-di 87, pet				
52	1,2-Diphenoxyethane (Ethylene glycol diphenyl ether)	98, al					4,4'-di 228-9, al	2',4'-di 215 2 (cor), pa yel, acet	<i>dı-p</i> 134–5, al			
53	Benzyl 2-naphthyl ether (2- Benzyloxynaphthalene)	101 5 (cor ), al	d	i		123 0 (cor)						
54	Anisoin (4,4 - Dimethoxy- benzoin)	113										Methyl ether, 52-3, yel, CCl <sub>4</sub> , Ethyl ether, 103-4, al-w
55	Hydroquinone dibenzyl ether (1,4-Dibenzyloxy- benzene)	128-9, al						83				103-4, d1 -w

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point "C	Boiling point °C	n <sup>D</sup>	D <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	I 3 5 Tri nitro benzene addition com pound	3 5- Dinitro- ben zoate	Miscellaneous
56	Anisil (4,4'-Dimethoxy- benzil)	133, yel										Monoxime, 133, syn-Dioxime, 217, anti-Dioxime, 195, bz, Disemicarbazone, 254 5, dil ac a, Dihydrazone, 118
57	Antiarol (5-Hydroxy-1,2,3- trimethoxybenzene)	148, w										Acetyl, 74, al, Methyl ether, 47, bp 271
58	Anhalamine (6,7-D1- methoxy-8-hydroxy- 1,2,3,4-tetrahydroiso- quinoline)	187-8, al				234-6						Dibenzoyl, 128-9, N-Benzoyl, 167 8
59	7-Methoxyquinoline	210	287758			229						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### EXPLANATIONS AND REFERENCES TO TABLES IX AND X

Phenylhydrazone \*

RCHO + 
$$H_2NNHC_6H_5$$
  $\rightarrow$  RCH= $NNHC_6H_5$  +  $H_2O$   
RR'CO +  $H_2NNHC_6H_5$   $\rightarrow$  RR'C= $NNHC_6H_5$  +  $H_2O$   
Phenylhydrazone

From the carbonyl compound with phenylhydrazine in methanol or ethanol

For directions and examples see Cheronis pp 497 8 Shriner, p 131

From the carbonyl compound with phenylhydrazine in aqueous acetic acid

See Wild, p 111

From the carbonyl compound with phenylhydrazine in methanol in the presence of acetic acid See Cheronis, p 511

From the carbonyl compound in alcohol with phenylhydrazine hydrochloride and sodium acetate in water See Vogel, p 721

p-Nitrophenylhydrazone \*

RCHO + 
$$O_2N$$
  $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHN=CHR +  $H_2O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHN=CRR' +  $H_2O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHN=CRR' +  $H_2O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$   $O_$ 

From the carbonyl compound with p-nitrophenylhydrazine and a catalytic amount of acetic acid in alcohol

For directions and examples see Shriner, pp 131, 219, Vogel, p 722, Wild, p 112

From the carbonyl compound in alcohol or water with p-nitrophenylhydrazine in aqueous acetic-hydrochloric acids

See G Petit, Bull Soc Chim France, 141 (1948)

#### 2 4-Dinitrophenylhydrazone (DNP-derivative) \*

RCHO + 
$$O_2N$$
  $\longrightarrow$   $NO_2$   $\longrightarrow$   $NHN=CHR$  +  $H_2O$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$ 

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in methanol or ethanol For directions and examples see Linstead, p 26, Shriner, p 219, Vogel, p 344, Wild, pp 114-5, O L Brady and G V Elsmie, Analyst, 51, 77 (1926), O L Brady, J Chem Soc, 756 (1931), H H Strain, J Amer Chem Soc, 57, 758 (1935), O L Brady and S G Jarret, J Chem Soc, 1021 (1950)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and 1% hydrochloric acid in methanol or ethanol

See Cheronis, pp 499-501, 511, Vogel, p 722, Wild, pp 112-4, C F H Allen, J Amer Chem Soc, 52, 2955 (1930), C F H Allen and J H Richmond, J Org Chem, 2, 222 (1937)

From the carbonyl compound with 2,4-dimitrophenylhydrazine and acetic acid in diglyme (diethylene glycol dimethyl ether)

See H J Shine, J Org Chem, 24, 1790 (1959)

From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated hydrochloric acid in diglyme (diethylene glycol dimethyl ether)

See Cheronis, p 501, H J Shine, J Org Chem, 24, 252 (1959), J Chem Ed, 36, 575 (1959)

#### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

### EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid See Vogel, p 344, G D Johnson, J Amer Chem Soc, 73, 5888 (1951), 75, 2720 (1953)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol See N R Campbell, Analysi, 61, 391 (1936)

From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine

See E A Braude and C J Timmons, J Chem Soc, 3131 (1953)

Semicarbazone \*

RCHO + 
$$H_2NNHCONH_2 \rightarrow RCH=NNHCONH_2 + H_2O$$
  
RR'CO +  $H_2NNHCONH_2 \rightarrow RR'C=NNHCONH_2 + H_2O$   
RR'CO +  $(CH_3)_2C=NNHCONH_2 \rightarrow RR'C=NNHCONH_2 + (CH_3)_2CO$   
Semicarbazone

From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate For directions and examples see Cheronis, pp 503-504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, J Amer Chem Soc, 41, 417 (1919)

From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate *See* Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, 52, 1267 (1930)

From the carbonyl compound and acetone semicarbazone in acetic acid See B Angla, Ann Chim Anal Chim Appl, 22, 10 (1940)

Thiosemicarbazone \*

RCHO + 
$$H_2NNHCSNH_2 \rightarrow RCH=NNHCSNH_2 + H_2O$$
  
RR'CO +  $H_2NNHCSNH_2 \rightarrow RR'C=NNHCSNH_2 + H_2O$ 

Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid For directions and examples see Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, J Chem Soc, 121, 873 (1922), W Baird, R Burns and F J Wilson, J Chem Soc, 2527 (1927), M Busch, J prakt Chem, 124, 301 (1930), P P T Sah and T C Daniels, Rec Trav Chim, 69, 1545 (1950)

Phenylsemicarbazone \*

RCHO + 
$$H_2NNHCONHC_6H_5$$
  $\rightarrow$  RCH= $NNHCONHC_6H_5$  +  $H_2O$   
RR'CO +  $H_2NNHCONHC_6H_5$   $\rightarrow$  RR'C= $NNHCONHC_6H_5$  +  $H_2O$   
Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid For directions and examples see P P T Sah and T -S Ma, J Chinese Chem Soc, 2, 32 (1934), C A, 28, 3713 (1934)

Oxime \*

RCHO + NH<sub>2</sub>OH 
$$\rightarrow$$
 RCH=NOH + H<sub>2</sub>O  
RR'CO + NH<sub>2</sub>OH  $\rightarrow$  RR'C=NOH + H<sub>2</sub>O  
Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent

For directions and examples see Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, J Amer Chem Soc, 53, 1536 (1931), W E Bachmann and C H Boatner, J Amer Chem Soc, 58, 2097 (1936), W E Bachmann and M X Barton, J Org Chem, 3, 300 (1938)

For a modification of the above method in aqueous alcohol

See W M D Bryant and D M Smith, J Amer Chem Soc, 57, 57 (1935)

From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

### EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

See: Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

See: Shriner, p. 255.

From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

See: Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, J. Amer. Chem. Soc., 53, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

See: Wild, p. 120.

Dimethone derivative (Methone derivative).\*

RCHO + 2(CH<sub>3</sub>)<sub>2</sub>C CH<sub>2</sub> 
$$\rightarrow$$
 CH<sub>2</sub>C CH HC CH<sub>2</sub>
 $CH_2$ CO  $CH_2$ 

Methone (Dimedone)

 $CH_2$ CO  $CH_2$ 

This derivative is specific for aldehydes only.

From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

For directions and examples see: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136-7; D. Vorlander, Z. Anal. Chem., 77, 241 (1929); Z. Angew. Chem., 42, 46 (1929); W. Weinberger, Ind. Eng. Chem., Anal. Ed., 3, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

See: E. C. Horning and M. G. Horning, J. Org. Chem., 11, 95 (1946).

Anhydride of dimethone derivative (substituted octahydroxanthene).\*

From the dimethone derivative with acetic anhydride.

For directions and examples see: Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

See: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, J. Org. Chem., 11, 95 (1946).

o-Dianisidine spot test.

RCHO + 
$$H_2N$$
 OCH<sub>3</sub> CH<sub>3</sub>O OCH<sub>3</sub>

$$RCH=N$$
 Schiff base (colored)

This test is usually applicable to aldehydes only.

From the aldehyde and a saturated solution of o-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

For directions and examples see: F. Feigl, Spot Tests in Organic Analysis, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, Mikrochim. Acta, 1, 55 (1927).

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

	Name	Boiling	Melting	- 20	Semi	2 4-Di nitro-	p-Nitro	Phenyl-	0	Dimeth one deriv	Dimeth one	Miscel	0-	Dianis spot te	
No	Name	point, °C	point °C	n <sup>20</sup>	carba- zone	phenyl hydra- zone	hydra zone	hydra- zone	Oxime	(Dime done deriv )	anhy- dride	laneous	Cold	Hot	Limit Y
1	Formaldehyde (Methanal)	-21	-91		169	167, yel al	181 2, yel, bz	145	oıl	189, al, 1914			pa yel	or br	50
2	Trifluoroacetalde- hyde	-20				151	02			1717					
3	l •	20 2	- 123 5	1 3392 <sup>18</sup> , 1 3316	162 3	stable 168, al un- stable 157, mix ture 148	128 5	57, 99	47	139, al	175-6, al	Thio- semicar- bazone, 146	of	dk br	30
4	Propionaldehyde (Propanal)	48 9	-81	1 364	89, bz - Igr , 154, w	148, or , 150, red, 155	125, yel, 50% al	oıl	40	154 6, al	143	Picrate, 156-7	dk ol gn	red	20
5	Glyoxal	50	15		270	328	311	180	178	mono 186, di 228	<i>mono</i> 224	Phenyl- osazone, 169-70			
6	Acrolein (Acralde- hyde)	52 4	-877	1 4025	171, w	165	150-1	50 l, hot lgr, pyra- zoline		192, 50% al	163, al		red br	vlt br	0 1
	Propynal (Propargyl aldehyde)											Cu deriv , 160			: :
	2,2,2-Trifluoro- propionaldehyde	56745			,	151									
9	Isobutyraldehyde	64	-65 9	1 3730	125 6	187, or - yel, al, 182	ог -	oıl	oıl	154	144				
10	2-Methyl-2-propenal (Methacrolein)	73 5		1 4191	198	206		74, py- razo- line							
11	n-Butyraldehyde (Butanal)	747	- <b>97</b> 1	1 38433	95 5, lgr , 106	123, al	87, yel, al, 93 5, red	93 5	b p 152 <sup>715</sup>	134, 142	141				
12	Trimethylacetalde- hyde (Pivaldehyde)	75	3, 6	1 3791	190	210, yel			41						
13	_				134-5d, 148, al				oil						
14	2-Chloropropion- aldehyde	86		1 43117								Hydrate, b p 80 5-81			
15	Dichloroacetalde- hyde	89 5- 90 5			155–6, using only I equiv- alent of re- agent				b p 67-917, using only 1 equivalent of re- agent						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling	Melting	p 20	Semi- carba-	2 4-Di nitro-	p-Nitro- phenyl-	Phenyl-	Oxime	Dimeth- one deriv	Dimeth	Miscel-	0-	Dianisi spot te	
No	Name	point, °C	point, °C	n <sup>20</sup>	zone	phenyl- hydra zone	hydra- zone	hydra- zone	Oxime	(Dime done deriv )	anhy dride	laneous	Cold	Hot	Limit, γ
16	Methoxyacetaide- hyde	92		1 3950		124 5	115					]			
17	3-Methylbutanal (Isovaleraldehyde)	92 5	-51	1 39225	107	123, yel - or , al	110 1, al	oil	48 5	154-5, al	173 (cor)	Thio- semicar- bazone, 52 3			
18	2-Methyl-1-butanal (α-Methylbutyr- aldehyde)	92-3	20, tri-	1 3942	103 5, bz - pet eth	120	The state of the s					<i>32 3</i>			
19	Trichloroethanal (Chloral, Tri- chloroacetalde- hyde)	98	-575	1 45572	90d	131	131, yel		56			Hydrate, 51 7			
20	Pentanal (Valeral- dehyde)	103 4	- <b>91</b> 5	1 3947		98, yel, al, 107			52, pet eth	104 5	113	Thio- semicar- bazone, 65			
21	tert-Butylacetalde- hyde	103		1 4150		147									
22	2-Butenal (Croton- aldehyde)	104	-69	1 436220 5	199	190, crim, bz-lt pet	184 5	56	119	183	163, sint, 167	Phenyl- semicar- bazone, 126-7	dk red	dk br - red	2
23	Dimethylethylacet- aldehyde	104				per						120-7			
24	Ethoxyacetaldehyde	106		1 3956		116 7 me al	113 4, al								
25 26	2-Isopropylacrolein 2-Butynal	107 9 105		1 4223 1 446 <sup>19</sup>		165 136									
27	Methylisopropyl- acetaldehyde	110 <sup>755</sup> 114		1 399825		124									
28	2-Bromoisobutyr- aldehyde	115		1 451825								Decom- poses in			
29	Diethylacetaldehyde (2-Ethylbutyralde- hyde)	116 117		1 4025	99, bz - lt pet	95, pa - or, lt pet, 129 30, al				102, me a1		w			
30	Methyl- <i>n</i> -propyl- acetaldehyde	116737			102	103									
	2-Methyl-2-butenal n-Propoxyacetalde- hyde	116 9 119 <sup>748</sup>			216	86									
33	Isobutylacetalde- hyde (Isocapro- aldehyde)	121743			127	99			b p 103 <sup>35</sup>						
34	Paraldehyde (Acetaldehyde trimer)	124 4 <sup>752</sup>	12 6	1 4049				:				Dilute acid → Acetal- dehyde,	dk ol grn	dk red br	4
	2-Pentenal 3-Methoxyisobutyr- aldehyde	125 129		1 403027	180	102	123					bp 202			

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling point	Melting point	π <sup>20</sup>	Semi carba	2 4-Di nitro phenyl	p Nitro	Phenyl hydra	Oxime	Dimeth one deriv	Dimeth one	Miscel	0	Dianis spot te	
	Ivanie	*C	°C	"6	zone	hydra zone	hydra zone	zone	Oxime	(Dime done deriv)	anhy dride	laneous	Cold	Hot	Limit Y
37	3-Chloropropion- aldehyde	130-1		1 47515							Toyon dalam	Trimer 35 5, dil HCl- abs al b p 170 512-5			
38	Hexanal (Capro- aldehyde)	131		1 4068	106, bz - pet eth	104, or - yei			51, pet eth me al	108 5, dil al		Phenyl- semicar- bazone, 135-6			
39	Ethylisopropylacet- aldehyde	133 5		1 408625		121									
40	3,3-Dimethyl- pentanal	134		1 4292		102									
41	3-Methyl-2-butenal (3-Methylcroton- aldehyde)	135		1 4526	223	182									
42	Cyclopentanecar- boxaldehyde	136			124										
43	2-Methylpenten-2- al-1 (3-Ethyl-2- methylacrolein)	136 8		1 4488	207	159, red al		58-60	48-48 8						
44	Tetrahydrofurfural	142-3***		1 4473 1 43658	166	134						Conc HCl → brt red col α Benzyl- α phenyl hydra zone 67 me al			
	5-Methylhexanal	144750		1 4114		117		140.5							
	3-Furaldehyde 1-Cyclopentenyl- formaldehyde	144 <sup>732</sup> 146		1 4945 1 4828 <sup>21</sup>	211 208		188	149 5							
49	2-Chloro-2-butenal (2-Chlorocroton- aldehyde)	147–50		1 478 <sup>23</sup>								Cyano- hydrin b p 137 826, ng/ 1 4762			
	2-Hexenal	150		l 4470 <sup>13</sup>	176		139					,62			
	3-Hexenal Heptanal (Enanth-	150 155	-45	1 4125	147 109, al	108,	73		57	135	112		red-	red	9
	aldehyde) Ethylisobutylacet-	155	- 70	1 7123	98	yel, al	, ,		,	133	112		br		
54	aldehyde Dı-n-propylacetal- dehyde	161		1 414215	101				b p 126 <sup>47</sup>				:		

<sup>\*</sup>Derivative data given in order  $\, m \, p$  , crystal color, solvent from which crystallized

No	Name	Boiling	Melting	F 40	Semi-	2 4-Di- nitro-	p Nitro	Phenyl-	0	Dimeth one deriv	Dimeth one	Miscel-	0	Dianisi spot te	
NO	Name	point, °C	point °C	u <sup>®</sup>	carba zone	phenyl- hydra zone	hydra zone	hydra- zone	Oxime	(Dime done deriv )	anhy dride	laneous	Cold	Hot	Limit,
55	2-Furancarbox- aldehyde (Fur- fural)	161 7	- 36 5	1 52608	202	212 4, yel, 230 (cor), red, mix- ture 185	54	97	$\alpha$ 75-6, pet eth, $\beta$ 91 2, al	160d	162 5	Phenyl- semicar- bazone, 180 I	dk red- vlt	dk bi - vlt	0 02
56	Hexahydro- benzaldehyde	162		1 449519	173, 176, w	172			90-1, pet eth			Oxime- HCl, 107-8d			
57	2-Ethylhexanal-1 (n-Butylethyl- acetaldehyde)	163		1 4150	254d	114 5, dil al, 120 1, yel, al									
58	2,2,3-Trichloro-n- butyraldehyde (n-Butylchloral, Crotonchloral)	164 5 5 5		1 47554					65			NH <sub>3</sub> → Butyl- chloral ammo- nia, 62			
59	Butanedial (Succinaldehyde)	169-70d		1 4254		280			di 172			Polymer, 65			
60	Octanal (n-Octalde- hyde Capryl- aldehvde)	171		1 42167	98, dil me al 101	106, yel, al,96	80, brt yel		60, me al	90, dil al	101	Thio- semicar- bazone, 94-94 5			
61	2-Ethyl-3-n-propyl- acrolein	173		1 451822	150 I, 153	124 5 122	:								
62	3-Fluorobenz- aldehyde	173			-		202	114	63						
63	2,2,2-Tribromo- ethanal (Bromal)	174, yel							115			Mono- hydrate, 53 5	no reac	dk grn	40
64	4-Fluorobenz- aldehyde	174 5 52					212	147	syn 116 7, anti 86						
65	2-Fluorobenz- aldehyde	175	-44 5				205	90	63						
66	Benzaldehyde	179	-26, fp -55 6	1 5446	222, 233-5, r htng	237, or, al	190, red, al 234 6, 262	158, 154-5	α 35 (sta ble) β 130, eth	193	200	Phenyl- semicar- bazone, 180 1	or	red- or	3
67	Nonanal (Pelargon- aldehyde)	185		1 4273	100 84, me al	100 (cor ), yel , al	0,202			86		Phenyl- semicar- bazone, 131 2			
68	5-Methylfurfural	187		1 514725	211*	212 (cor)	130, red	147-8	syn 112, anti 51-2						
69	Glutaraldehyde	187-9d		1 433025	:		169		di 175, 178, w						
70	Phenylethanal (Phenylacetal- dehyde)	194	33	1 53191	153, dil al , 156	121, grn - yel , al , 110		58, lgr, 62-3	97-8, eth , 100	165	126		dk br - red	dk br	polym

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling	Melting	_20	Semi	2 4-Di nitro	p Nitro- phenyl	Phenyl	Oxime	Dimeth- one deriv	Dimeth one	Miscel-	0-	Dianisi spot te	
INO .	Name	point °C	point °C	n <sup>D</sup>	carba zone	phenyl hydra- zone	hydra zone	hydra zone	Oxime	(Dime done deriv)	anhy dride	laneous	Cold	Hot	Limit,
71	2-Hydroxybenz- aldehyde (Salicyl- aldehyde)	197 (cor)	-7, fp 16	1 574	231	248, red, abs al 252d, lt red, ac a	227, red- br, al	142	57, 63		208, 70% al	p-Nitro- benzo- ate, 128	or	ог	5
72	2-Thiophenecarbox- aldehyde	198		1 595016		242		119					<u> </u>		Į.
73	3-Methylbenz- aldehyde (3-Tolu- aldehyde)	199		1 541321	204 223 4	212, 194	157	91, lgr, 84	60, lgr	172	206		dk or - red	ch red	5
74	2-Methylbenz- aldehyde (2-Tolu- aldehyde)	200		1,5481	209 al, 212, 218	193 4, red, ac a	222, red, al	101, 105 6, 111	49	167	215		dk or - red	ch red	5
75	4-Methylbenz- aldehyde (4-Tolu- aldehyde)	204 5		1 5454	234, al , 215	1	200 5 (cor), dk red, ac a	112-3, al, 121	79-80, 110				dk or - red	ch red	5
76	d-Citronellal (d-Rhodinal)	207		1 4485	83-4, chl, ppt by lgr 91 2	78, yel, al			oıl	77 9, dıl al	173		dk grn	brt red	10
77	<b>Decanal</b> (Captaldehyde)	207-9		1 4287	102	104, yel			69, dil me al	91 7, dıl al		Thio- semicar- bazone, 99-100	pa ol	dk br	200
78	2-Chlorobenz- aldehyde	213-4	11	1 56708	146. yel, 225, pyr, 229- 30, me	213 6 (cor), 209, or red, xyl	237 8, red, al, 241, br - red, 249,	86	α 75-6, al, β 101-3	205d , al	224 6 (cor), al	99-100			
79	Phenoxyethanal (Phenoxyacetalde- hyde, Glycolalde-	215d		1 538021	145		or	86, pa yel, al	95, pet eth						
80	hyde phenyl ether) 3,5-Dimethylbenz- aldehyde	220-2	9	1 5385	201 2							Oxid → acid,			
81	3-Phenylpropion- aldehyde (Hydro- cınnamaldehyde)	224			127, al	149, yel, al	122 3, yel, dıl al		93-4 5, dil al 97 (cor)			170, al			
82	Citral a. (Geraniał)	228d		1 48752	164, me al	red-or			143 5				dk red	red blk	0 1
83	Citral b. (Neral)	228d		1 4900	HCl 171, mix- ture 132,	al , 116 96, red- or , al							dk red	red blk.	01

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Boiling	Melting	40	Semi	2 4 Di nitro	p Nitro	Phenyl	Oxime	Dimeth- one deriv	Dimeth one	Miscel		Dianisi spot te	
NO	Name	point, °C	point °C	n <sub>D</sub>	carba zone	phenyl- hydra- zone	hvdra zone	hydra zone	Oxime	(Dime- done deriv )	anhy dride	laneous	Cold	Hot	Limi Y
84	2,6-Dimethylbenz- aldehyde	228742	11		158										
85	3-Methoxybenz- aldehyde (3-Anis- aldehyde)	230	3 4	1 5538	233d		171	76	39 40 pet eth. 112			Phenyl- thio- semicar- bazone, 153	dk or	red br	0 4
86	3-Bromobenz- aldehyde	234-6			205		220	141	72			133	į		
87	4-Isopropylbenz- aldehyde (Cumal- dehyde)	236		1 5301	211, me al	241, red bz, 243, red, ac a, 244 5, al -chl	190, al	129, al	α 52, al β 111	170-1, al	172 3		dk red	ol yel	3
88	3-Ethoxybenz- aldehyde	245 5		1 5408		 						ļ	l l		
89	4-Methoxybenz- aldehyde (4-Anısal- dehyde)	248	2 5	1 5731	210, 203	253 4d, red, ac a, 250, red, xyl	160, red- vlt	120 1. wh. dil al	α' 64- 5, bz α 4 5 (from α' on fu- sion) β 133, bz	144 5 (cor), al	243 (cor), al		dk or	red- br	0 4
90	3-Phenylpropenal (Cinnamaldehyde)	252d	<b>-75</b>	1 61949	215 6 w	255d , red, ac a	195, red, al	168, yel, dil al	α 64-5, lgr ,β 138 5, bz	213 (cor), al 161, al	175, al		dk ch red	ch red	0 05
91	4-Ethoxybenz- aldehyde	255, 249	13-4		202d, al, 208				svn 157 anti 118						
92	3,4-Diethoxybenz- aldehyde (Proto- catechualdehyde diethyl ether)	277-80							98			Oxid → acid, 165		}	
93	Diphenylacetalde- hyde	315–6d			162				α 120, β 106			Oxid → Benzo- phenone 48			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)\*

No	Name	Boiling	Melting	_ 20	Semi carba	2 4 Di nitro	p Nitro	Phenyl	Oxime	Di meth one	Dı meth	Miscellaneous		namisid pot tesi	
No	Name	point °C	point °C	π <sup>20</sup>	zone	phenyl hydra zone	hydrazone	hydra zone	Oxime	deriv (Dime done deriv)	one anhy dride	Miscenaneous	Cold	Hot	Limit 7
1 2	7-Methyloctanal 3-(2-Furyl)propionalde- hyde	94 <sup>120</sup> 70 <sup>14</sup>		1 4470	80 80	100									
3	2-Methyloctanal	8320			80		İ	l			ļ				1
4	2,3-Dichloro-n-butyr- aldehyde	58 60 <sup>20</sup>		1 461821	96 7				oil						İ
5	Octanal (n Octaide hyde)	8132		1 4217	98 101	106 yel	80		59 60	89 8		]	}		
6	Undecanal (Hen decanal)	12020	-4	1 432423	103 me al	104 yel			72 wh me al			Timer 47 8			į
7	Tridecanal (n Tridecyl aldehyde)	1368	15		106 al	108			80 5 dil		<u></u>	Trimer 61 5			
8	2-Hydroxypropionalde- hyde	1149			114 w		127								
9	2-n-Amylcinnamalde- hyde (2 n Pentyl cinnamaldehyde Jasminaldehyde)	312 312		1 5381	118	l64 red al			74 al w						
10	2-Methyl-3-phenyl- propionaldehyde	90°			123										
11:	2-Hydroxy-2-methyl hexanal (n Butyl methylglycolalde hyde)	87 83			143										
12		83		1 5360	146	138		1	95	Ì					
13	2-Ethyl-2-hexenal	7320	1		152	125									ľ
14	2-Ethyl-3-hexenal	8452			156										
15	•		}	1 450925	159	125	<b>\</b>	<b>\</b>				ŧ			
16	2-Nonenal	12621		1 4426	165	126	113		Ì						
17 18	2-Heptenal 2,3,6-Trimethylbenz-	85 <sup>14</sup> 114 <sup>10</sup>	ļ	1 4314	169 169		116		126		ļ				ļ
19	aldehyde 3,5-Dimethylhexahydro- benzaldehyde	71''			171										
20		1014			182 3										
21	2,4,6-Trimethylbenz- aldehyde	98 <sup>6</sup> 128 <sup>15</sup>		1 5524	188										
22	2-Hvdroxv-2-phenyl- butvraldehyde (Ethyl phenylglycolaldehyde)	110 11			188										
23	2-Hvdroxvbutvralde hvde (Aldol)	832			194		109 11 red yel dil al		sin 112 anti 51 2	146 8 30° me al	126	4 Bromo phenylhy drazone 127 8			•
24	1,2,3,4-Tetrahydro-2-	921			197										
25	naphthaldehyde 2-(1-Naphthyl)- propionaldehyde	1322			204										

<sup>\*</sup>Derivative data given in order m p crystal color solvent from which crystallized

### TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Boiling	Melting point	n 20	Semi carba	2 4 Di nitro phenyl	p Nitro	Phenyl hydra	Oxime	Di meth one deriv	Di meth	Miscellaneous	1	Dianisid pot tes	
140	Nume	°C	°C	"Đ	zone	hydra zone	hydrazone	zone	Oximic	(Dime done deriv )	anhy dride	Wiscenaneous	Cold	Hot	Limit γ
26	1.6-Hexanedial (Adipic dialdehyde)	94 <sup>12</sup> , 70 <sup>3</sup>		1 4350	dı 206				di 185 6						
27	2-Methylcinnamalde- hyde	12414		1 605717	208, al - w										
28	Phenyigiyoxai	10815			mono 208 9d yel al bis 229d		309					91 (mono hyd ) w 2 Thio semicarba zone, 170 yel al			
30	Cyclohexenecarbox- aldehyde	7013		1 49211	213				99						
31	2-Phenoxybenzaldehyde	1531			215										

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES a) Liquids 3) Miscellaneous; reduced pressure b.p. only (listed alphabetically)\*

No	Name	Boiling point	Melting point,	n 20 D	Semi carba	2,4 Di nitro phenyl-	p-Nitro- phenyl	Phenyl-	Oxime	Di meth one deriv	D <sub>1</sub> meth- one	Miscellaneous		Dianisions	
		·c	*c		zone	hydra- zone	hydra- zone	zone		(Dime done deriv )	anhy- dride		Cold	Hot	Limit γ
1	2-Chloroacrolein	29 31 17		1 463								Diethylacetal, bp 158 60			
2	4-Chloro-n-butyraldehyde d,l-2,3-Dichloropropion- aldehyde	50 I <sup>11</sup> 48 <sup>14</sup>		1 44662* 5 1 4762		134 5	110		74 5			Dimethylacetal, b p 78-8213, nl <sup>8</sup> 1 144			
4	2-Heptynal	5413		1 4521 17	ł	74		[ i				" <b>,</b>			
5		6511		1 537222				102	160						
6	4-Hydroxy-n-butyr- aldehyde	68*		1 4403		118								ĺ	
7	3-Hydroxy-2-isopropyl- propionaldehyde	8410				126									
	3-Hydroxy-3-methyl- n-butyraldehyde	6713				İ	142								
9	4-Methoxy-2-methyl-n- butyraldehyde	6655		1 428025		88									
10	5-Methyl-2-thiophene- carboxaldehyde	11425		1 578229				126							
11	3-Methyl-2-thiophene- carboxyaldehyde	11425		1 583325				149							
	4-Octenal	8413		1 446325		108								1	
	Phenylpropargyl alde- hyde	116 717		1 603225					108, Igr						
	2-Phenylpropionaldehyde	764	i			135		150							
	(Nicotinaldehyde)	99 26						158							
	2,2,4-Trichloro- <i>n-</i> butyr- aldehyde		fp-78									HNO <sub>3</sub> → acid, 73 5			
17	2,4,6-Trihydroxybenzalde- hyde (Phloroglucinalde- hyde)		d						195d , (hyd ), w			2,4,6 Triacetate 156 7, al 2- Benzoate 198 200, chl			
18	<b>4-Vinylbenzaldehyde</b> (4- Formylstyrene)	9314		1 596025				131				200, 611			

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting	Boiling	Semi	2 4-Dı- nıtro	p Nitro	Phenyl	0	Dimeth one deriv	Di meth	Miscellaneous	o	Dianision spot tes	
	Name	point °C	point °C	carba zone	phenyl hydra zone	phenyl- hydrazone	hydra zone	Oxime	(Dime done deriv )	one anhy dride	Miscellaneous	Cold	Hot	Limit Y
1	3-Chlorobenzaldehyde	17 8	213 4	228, pyr 230, me al	248, dk red, xyl, 256, or - yel	216, dil al	134 5, abs al	α, anti 70 1, al β, syn 118			ng <sup>2</sup> 2 1 55908			
2	2,3,5,6-Tetramethyl- benzaldehyde	20	13511	270d				125						
3		20 2 6-7	247 9	219, al				57 9, pet eth			Diacetate 88 9, ac anh			
4	Tetradecanal (Myrist- aldehyde)	23 3 5	16624	106 5, dil al	108	95 brt yel		82 5 3 5, dil al			Trimer, 65			
	Pentadecanal	24 5	16014	106 5, al	106 7, yel, pyr-al	94 5, yel, al		86, dil al			Trimer, 69 70			
(C) 16	Hexadecanal (Palmit- aldehyde)	34		107, dil al , 108-9	108	96 5, yel , eth		88, yel			Trimer, 73 Thiosemicarbazone, 106 9			
7	1-Naphthaldehyde	34	292 16218	221		224	80	98 90						
8	Phenylacetaldehyde	34	195	156, 163	121	151	mono 63, 58, di 101-2	99, 103	165					
9	4-Methoxy-1-naphthal- dehyde	34, wh	20011				113				Azıne 185, yel, al			
10	(5-Hydroxymethyl) furfural	35 6	115 20° 5	195d al, recr tol - lgr	184 red	185 dk red, al	140 1, tol	77 8, 108						
11	Heptadecanal (Margaric aldehyde)	35-6, 63						89 5, et ac			Trimer, 77-8, It pet			
12	3,4-Methylenedioxy- benzaldehyde (Piperonal)	37	263	230, 234, 237	265d , xyl , 266d , red, ac a	199 200, red	102 3, yel, al, 99, 106	syn 146, me al , anti 112, w	177 8, 193, yel, al	220 (cor)		brt red	dk red	4
13 14	2-Iodobenzaldehyde Octadecanal	37 38	12914	206 108-9	101,110	101, yel,	79	108 89			Thiosemicar-			
	hyde (o-Anisalde- hyde, Salicylalde- hyde methyl ether)		243-6 (cor)	215d , al	253 5 (cor ), red, xyl	me al 204-5, br red		92, dıl al			bazone, 111 n <sup>2</sup> 0 1 5598			
16	2-Aminobenzaldehyde 4-Diethylaminobenz-	40 41	1727	241d,		220	221 103,	135 93						
(	aldehyde			al			yel - br							
18	<b>Dodecanal</b> (Lauralde- hyde)	2 forms a) 42-3 b) 11	238	103, 106	106, yel	90		76-7, eth, 77-8, me al			Thiosemicar- bazone, 100			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point	Boiling point	Semi carba-	2 4 Di nitro- phenyl	p-Nitro- phenyl-	Phenyl- hydra-	Oxime	Dimeth one deriv	Di meth- one	Miscellaneous	0	Dianision spot tes	
140	Name	°C	*C	zone	hydra zone	hydrazone	zone		(Dime done deriv )	anhy dride	Miscellatieous	Cold	Hot	Limit,
19	3,4-Dichlorobenz- aldehyde	43 4	247 8			276 7, or		syn 120 al , on fusing →						
								anti 114 5 118-9						
	3-Phenylcinnamalde- hyde	44	21014	214 5	196		173, yel							
	2,4,5-Trimethylbenz- aldehyde	44	12010	243			127							
22	2-Nitrobenzaldehyde	44		256	265	263	156	anti 102 syn 154, bz				grn br	red br	5
23	3,4-Dimethoxybenz- aldehyde (Veratralde- hyde)	44, 58	285	177	261 3 (cor), or, PhNO <sub>2</sub> 264 5		121, al.	1	173					
24	4-Chlorobenzaldehyde	48	214 5 6 5	230, pyr 233, me al	254 (cor), or	237, dk br, al	127 7 5, It yel, dil al	α 110, β 146						
25	2-Pyrrolecarboxalde- hyde	50	217 9	183 5, w		182 3, red, xyl	139, lgr	164, bz			nb 1 5939			
26	Benzylglycol- aldehyde	52	121*	137							Benzoate, 70			
27 28	Furfural diacetate 4-Chloro-2-hydroxy- benzaldehyde	52, eth 52 5	220	212 pa yel, ac a		257, or , ac a		155, col , al.					•	
29	Quinoline-4-carbox- aldehyde	51 3, tol (anh ), 84 4 5 (mono- hyd )	1234	ac a		261 2 yel al		181 2 me al			Picrate, 179			
30	2-Ethyl-4-hydroxy- benzaldehyde	53	1451											
31	2-(2-Furyl)-acrolein	54, lgr	959	219 5			132, pet eth	110 1						
32	<b>2,3-Dimethoxy- benzaldehyde</b> ( <i>o</i> - Veratraldehyde)	54	13712	231d			138	99, al -w						
	9-Hydroxynonanal	54	1200 1											
	2,3-Diphenylpropional- dehyde		17011	125										
35	3-Benzyloxybenzalde- hyde	54	21820											

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting	Boiling	Semi-	2,4-Di- nitro-	p-Nitro	Phenyl- hydra-	Oxime	Dimeth one deriv	Dı meth-	Marillana	0	Dianision of test	
No	Name	point, °C	point °C	carba- zone	phenyl- hydra- zone	phenyl- hydrazone		Oxime	(Dime- done deriv )	one anhy- dride	Miscellaneous	Cold	Hot	Limit,
36	3-Chloro-2-hydroxy- benzaldehyde (3- Chlorosalicylalde- hyde)	54 5 5 5		240-3, 50% ac a				167-8, dil al			5 Nitro deriv , 129, yel , dil al			
37 38	Octatrienal Isoquinoline-1-carbox-	55 55 5		197			171 2							
39	aldehyde Phthalaldehyde	56		Į.			dı 191					brt yel	brt yel	
40	2,3,5-Trichlorobenz- aldehyde	56 col, dil al									Oxid KMnO <sub>4</sub>	ppt	ppt	
41	2-Hvdroxy-5-methyl- benzaldehyde (5- Methylsalicylalde hyde)	56 dil al	217 8				149 yel, al	105, w			acid, 162 3 Diacetate, 94, al			
42	3-Iodobenzaldehyde	57		226	120 257	212 207 8	155	62						
43	4-Bromobenzaldehyde	57		228, 229	128, 257	207 8	113	syn 157, anti 111			,			
44	3-Nitrobenzaldehyde	58		246	293d	247	120, 124	120 122						
45	2,5-Dichlorobenz- aldehyde	58	231-3				104-5, al	127 5-8, dil al						
46	2,4,6-Trichlorobenz- aldehyde	58-9												
	2-Phenanthraldehyde Paraisobutyraldehyde (2,4,6-Tri-isopropyl-	59, 59 5 59 60	195 (cor ),	282				175			See Isobutyr- aldehyde			
49	1,3,5-trioxan)  1-Hydroxy-2-naphthal-dehyde	59 60, gm -	sl de- polym					145, bz			<b>р</b> р 64			
	uenyue	yel, al-												ĺ
50	2-Naphthaldehyde	60, w	15015	245, al	270	230	205 6 d,al, 217 8	156, dil al						
51	4-Phenylbenzaldehyde	60		243d , al	239d , scar , xyl		189d	149-50						
52	3-Methoxy-1-naphthal- dehyde	60, pet eth		200, al - w	^,,,	197, red,		102, al - w						
53	4-Ethoxy-3-methoxy-	64	İ	"		ac a		•						
54	benzaldehyde 3,5-Dichlorobenz- aldehyde	65	235 40 <sup>748</sup>				106 5, yel, pet eth	112						
55	2,3-Dichlorobenz- aldehyde	65 7												
56	5-Methoxy-1-naphthal- dehyde	66, yel, pet eth		246, ac a -w		246, red, ac a -w		104, w						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point,	Boiling point,	Semi- carba-	2,4-Dı- nıtro- phenyl-	p-Nitro- phenyl-	Phenyl- hydra-	Oxime	Dimeth one deriv	Dı- meth- one	Manallana	o	Dianision of the spot test	
NO	Name	°C	°C	20ne	hydra- zone	hydrazone	zone	Oxine	(Dime- done deriv )	anhy dride	Miscellaneous	Cold	Hot	Limit, γ
57	Dibenzofuran-2- carboxaldehyde	68					162							
58	2,6-Dichlorobenzalde- hyde	70–1									o-Nitro- phenylhydra- zone, 154, p- Bromo- phenylhydra- zone, 142			
59	2,4-Dimethoxybenz- aldehyde (β- Resorcylaldehyde dimethyl ether)	71, dil al, 69	16510					106, w			5-Nitro deriv 188 9, me			
60	Quinoline-2-carbox- aldehyde	71, pet eth (anh), 51 (mono- hyd), w				250, yel , 225, subl	204, yel, al	188					11 - 12 - 12 - 12 - 12 - 12 - 12 - 12 -	
61	4-Ethoxy-1-naphthal- dehyde	72									Hydrazone, 160 182, dk red, Azıne, 209, yel, PhNO <sub>2</sub>			
62	4-Aminobenzaldehyde	72	1	153			156	124			Turvoy	or or	red br	0 4
63	2,4-Dichlorobenzalde- hyde	72, 74 5						136 7			Oxime HCl, 133 5			
64	4-Dimethylamino- benzaldehyde	74		222	325	182	148	185						
65	4-Methylthiazole-5- carboxaldehyde	75, 72 5	11821				159, 161							
66	Quinoline-6-carbox- aldehyde	75 6 (anh), 55		239, yel, al			185, red, al	191, yel, al			Methiodide, 218, yel, al			
67	3,4,5-Trimethoxy- benzaldehyde (Gallaldehyde tri- methyl ether)	(hyd ) 78, 75	163-510	219-20		201-2		83 4		i				
	4-Iodobenzaldehyde	78		224	257	201	121	1.45						
	3-Phenanthraldehyde 4-Hydroxy-3-methoxy- benzaldehyde (Vanillin)	80 80 1, w	285d	275 230, 240d.	271d (cor), red, ac ac, 268	227, ac a, 223	105, bz	145 117, w , 122	196-8 (cor ), al	228	2,4-Dinitro- phenyl ether, 131	brt or red	ch red	3
71	2-Hydroxy-1-naphthal- dehyde	82, al	19227	240, yel, me al	40,200			157			Picrate, 120	or	brk red	10
72	Stilbene-2-carbox- aldehyde	83												
73	2-Methoxy-1-naphthal- dehyde	84, al	200-111							İ	Azıne, 255-6, yel, PhNO₂			

<sup>\*</sup>Derivative data given in order  $\, m \, p$  , crystal color, solvent from which crystallized

No	N	Melting	Boiling	Semi-	2,4-Di- nitro-	p-Nitro- phenyl-	Phenyl-	0	Dimeth- one deriv	Di meth- one	Miscellaneous	0-	Dianisid spot test	
No	Name	point, °C	point °C	carba- zone	phenyl- hydra- zone	hydrazone	hydra- zone	Oxime	(Dime- done deriv )	anhy- dride	Miscenaneous	Cold	Hot	Limit, Y
74	2,3,6-Trichlorobenz- aldehyde	86 7									Ac anh + ac a + NaOAc → 2,3,6-tri- chlorocin-			
75 76	Isophthalaldehyde 3,4,5-Trichlorobenz- aldehyde	89 90 l, al		252-4, al		342d, or, PhNO <sub>2</sub>	242 147	180			namic acid, 189, ac a  2-Nitro deriv, 118 5 9 0 Oxid alk KMnO <sub>4</sub> 3,4,5-tri- chloroben- zoic acid,			
77	Phenylglyoxal hydrate	91		α 217d		309	dı 152				210			
78	2,3,4-Trichlorobenz- aldehyde	91						di 168		i	Ac anh + ac a + NaOAc → 2,3,4-tri- chlorocin- namic acid, 185			
79	Quinoline-8-carbox- aldehyde	94 5, dil al		238 9, bz			176, yel, al	115, dıl al			103			
80	2-Phenylcinnamalde- hyde	94, al , 95	195 2001	188-9, al, 195			125 6, yel, ac a, 141	165~6, al					1	
81	3,5-Dichloro-2-hy- droxybenzaldehyde (3 5-Dichlorosalicyl- aldehyde)	95 6		227d . ac a			pa pel, al	195-6, al-w (4-1)			Ac anh + ac a + NaOAc → dichloro- coumarin, 160, bz			
82	Hydroxyacetaldehyde (Glycolaldehyde)	96 7					162				Phenylosa- zone, 178 9, yel, eth, p- Nitrophenyl- osazone, 311			
83	3-Chloro-n-butyr- aldehyde (Trimer)	96 7	28-3313								55425116, 511		[	
84	2,2-Dimethyl-3-hy- droxypropionaldehyde	97	8515											
85	2,3,4,6-Tetrachloro- benzaldehyde	97 8				] [								
86	Benzaldehyde-2- carboxylic acid (2- Formylbenzoic acid,	98 9 (hyd), 240-50		202				120, w						
87	Phthalaldehydic acid) 3-Hydroxy-2-naphthal- dehyde			>270, me al			246-8	207d						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		Melting	Boiling	Semi	2 4-Di	p-Nitro-	Phenyl-		Dimeth- one	D <sub>1</sub>		,	Dianision Spot tes	
No	Name	point °C	point °C	carba	phenyl- hydra- zone	phenyl hydrazone	hydra-	Oxime	deriv (Dimedone deriv)	one anhy dride	Miscellaneous	Cold	Hot	Limit,
88	benzaldehyde	99 100	10512	286-7, ac a		245	150 2	128 w 123 4						
89 90	9-Phenanthraldehyde 3-Hydroxybenzalde- hyde	101 104 108 (cor), w	240	198, 199	259, scar , xyl 260d , red, al	265 221 2, dil ac a	130 1 5, tol , 147, recr bz	157 90, 88				dk br red	dk ch red	4
91	9-Anthraldehyde	105		219, yel, al			207, or, al	187	ļ					
	4-Nitrobenzaldehyde	106		221, 211	320	249	159, 153	anti 133, 129, syn 182 4				pr or	red br	1
	2,3,4,5-Tetrachloro- benzaldehyde 2,3-Dihydroxybenz-	106 6 5		226d			167							
95	aldehyde 2-Chloro-5-hydroxy- benzaldehyde	110 5- 1 5, ac a		236, pa yel			250 1, red, dil		146 7, abs al				}	
96	1-Phenanthraldehyde	111 5					<b>3</b> 1	189						
98	2,4,5-Trichlorobenz- aldehyde	112-3, al									Ac anh + ac a + NaOAc → 2,4,5-tri- chlorocin- namic acid, 200 1			
99	3-Hydroxy-2,4,6-tri- chlorobenzaldehyde	113-6 5, 50% ac				272-3d , yel or	,	170-2, dil al						
100	2-Ethoxy-1-naphthal- dehyde	115, al		214-5, yel, al			91				Azıne, 184, yel, PhNO <sub>2</sub> - al			
101	Metaldehyde	115, 246, (poly- mers)									Dil a → acetaldehyde, b p 20 2			
102	4-Hydroxybenzalde- hyde	116-7, w		224, 280d	280d, purp, ac a, 260 (mono- hyd), red, w	266	177 8, al, 184, slow htng	72, 112 (anh)	188-90 (cor), 184	246		dk or red	ch red	5
103	Terephthalaldehyde	116, 118	245		100, ₩	dı 281	dı 278d , 154	dı 200						
104	2,4,6-Trimethoxybenz- aldehyde	118						201-3, me al						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point	Boiling point	Semi carba	2 4 Di- nitro phenyl	p Nitro	Phenyl hydra	Oxime	Dimeth one deriv	Di meth one	Miscellaneous	0	Dianisid spot test	
140	Name	°C	°C	zone	hydra zone	hydrazone	zone	)	(Dime done deriv )	anhy dride	Miscenaneous	Cold	Hot	Limit Y
105	1-Bromo-2-naphthal- dehyde	118									Oxid → acid			
106	4-Chloro-3-hydroxy- benzaldehyde	121		238 9, pa yel		226 7 vit red dil al		126 (anh ) 106 10d (mono- hyd )						
107	Pyrene-3-carboxalde- hyde	126												
108	1,2,3,4-Tetrahydro- phenanthrene-9- carboxaldehyde	129												
109	4,6-Dichloro-3-hy- droxybenzaldehyde	129 30	l								2 Nitro deriv 157	}		
110	2,4-Dihydroxybenz- aldehyde (β-Resorcyl- aldehyde)	135-6, yel, w		260d	286d brt red AmOH		156 60d	191, w			3,11			
111	3-Chloro-4-hydroxy- benzaldehyde	139 (cor )		210d, yel,v dil ac a		:		144 5, w						
112	2-Chloro-3-hydroxy- benzaldehyde	139 9 5		236 7, pa yel		244 5 or red,		149 dul al						
113	2,6-Dichloro-3-hy- droxybenzaldehyde	140 2						174 5 dıl al						
114	2,4-Dichloro-3-hy- droxybenzaldehyde	141, ac a				277 8, or red		188, al						
115	d.l-Glyceraldehvde (dimer)	142, 40°, me al		160d	166 7 (cor), 50° a me			117 8	197 (cor) 50°, al 203	172 50°, al				
116	2-Chloro-4-hydroxy- benzaldehyde	147 8 w		214, yel al		284d dk red al		194 al	203					
117	3,4-Dihydroxybenz- aldehyde (Proto- catechualdehyde)	153 4, w		230d	275d , dk red, me al		175 6d, w 121 8	157, xyl	145d , al		Dibenzoate 96 7, al			
118	3,5-Dihydroxybenz- aldehyde (α-Resor- cylic aldehyde)	156 7		223 4										
119	3,5-Dichloro-4-hy- droxybenzaldehyde	158 9 (cor ), 156, dıl al		236 7d (cor), grn - yel, ac a				185, dıl al						
120	Hydroxypyruvic aldehyde	160						135						ļ
121		163		242				124						
122	Benzaldehyde-3- carboxylic acid (3- Formylbenzoic acid)	175, w		265			164	188d						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point,	Boiling point,	Semi carba	2.4 Di nitro- phenyl-	p Nitro	Phenyl- hydra-	Oxime	Dimeth one deriv	D1- meth	Miscellaneous	1	Dianisid spot tes	
140	Haine	°C	°C	zone	hydra- zone	hydrazone			(Dime- done deriv)	anhy dride	1411SCHARCOUS	Cold	Hot	Limit Y
123	2-Hydroxybenzalde- hyde-3-carboxylic acid (3-Formyl- salicylic acid)	179					188, al	193, yel , w						
124	4-Hydroxy-1-naphthal- dehyde	181, yel , w		224		į					Hydrazone, 220-36, dk red Azine, 236, yel, PhNO,			
125	Indole-3-carboxalde- hyde	195, 198					198				1			
126	Pentachlorobenz- aldehyde	202 5					152 5 (cor), yel,	201 (cor), bz						
127	3,4-Benzypyrene-5- carboxaldehyde	203												
128	3,4,5-Trihydroxybenz- aldehyde (Gallalde- hyde)	212d , (mono- hyd )				226, 234- 6d		195- 200d						
129	4-Hydroxybenzalde- hyde-3-carboxylic acid (5-Formyl- salicylic acid)	248-9					219, al	179						
130	Benzaldehyde-4- carboxylic acid (4- Formylbenzoic acid)	256, w , subl					226	208-10						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLES IX AND X

Phenylhydrazone \*

RCHO + 
$$H_2NNHC_6H_5$$
  $\rightarrow$  RCH= $NNHC_6H_5$  +  $H_2O$   
RR'CO +  $H_2NNHC_6H_5$   $\rightarrow$  RR'C= $NNHC_6H_5$  +  $H_2O$   
Phenylhydrazone

From the carbonyl compound with phenylhydrazine in methanol or ethanol

For directions and examples see Cheronis pp 497 8 Shriner, p 131

From the carbonyl compound with phenylhydrazine in aqueous acetic acid

See Wild, p 111

From the carbonyl compound with phenylhydrazine in methanol in the presence of acetic acid See Cheronis, p 511

From the carbonyl compound in alcohol with phenylhydrazine hydrochloride and sodium acetate in water See Vogel, p 721

p-Nitrophenylhydrazone \*

RCHO + 
$$O_2N$$
  $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHN=CHR +  $H_2O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHN=CRR' +  $H_2O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHN=CRR' +  $H_2O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\longrightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$   $O_2N$   $\rightarrow$  NHNHH<sub>2</sub>  $\rightarrow$   $O_2N$   $\rightarrow$   $O_$ 

From the carbonyl compound with p-nitrophenylhydrazine and a catalytic amount of acetic acid in alcohol

For directions and examples see Shriner, pp 131, 219, Vogel, p 722, Wild, p 112

From the carbonyl compound in alcohol or water with p-nitrophenylhydrazine in aqueous acetic-hydrochloric acids

See G Petit, Bull Soc Chim France, 141 (1948)

#### 2 4-Dinitrophenylhydrazone (DNP-derivative) \*

RCHO + 
$$O_2N$$
  $\longrightarrow$   $NO_2$   $\longrightarrow$   $NHN=CHR$  +  $H_2O$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NO_2$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$   $\longrightarrow$   $NHN=CRR'$  +  $H_2O$ 

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in methanol or ethanol For directions and examples see Linstead, p 26, Shriner, p 219, Vogel, p 344, Wild, pp 114-5, O L Brady and G V Elsmie, Analyst, 51, 77 (1926), O L Brady, J Chem Soc, 756 (1931), H H Strain, J Amer Chem Soc, 57, 758 (1935), O L Brady and S G Jarret, J Chem Soc, 1021 (1950)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and 1% hydrochloric acid in methanol or ethanol

See Cheronis, pp 499-501, 511, Vogel, p 722, Wild, pp 112-4, C F H Allen, J Amer Chem Soc, 52, 2955 (1930), C F H Allen and J H Richmond, J Org Chem, 2, 222 (1937)

From the carbonyl compound with 2,4-dimitrophenylhydrazine and acetic acid in diglyme (diethylene glycol dimethyl ether)

See H J Shine, J Org Chem, 24, 1790 (1959)

From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated hydrochloric acid in diglyme (diethylene glycol dimethyl ether)

See Cheronis, p 501, H J Shine, J Org Chem, 24, 252 (1959), J Chem Ed, 36, 575 (1959)

#### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

### EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid See Vogel, p 344, G D Johnson, J Amer Chem Soc, 73, 5888 (1951), 75, 2720 (1953)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol See N R Campbell, Analysi, 61, 391 (1936)

From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine

See E A Braude and C J Timmons, J Chem Soc, 3131 (1953)

Semicarbazone \*

RCHO + 
$$H_2NNHCONH_2 \rightarrow RCH=NNHCONH_2 + H_2O$$
  
RR'CO +  $H_2NNHCONH_2 \rightarrow RR'C=NNHCONH_2 + H_2O$   
RR'CO +  $(CH_3)_2C=NNHCONH_2 \rightarrow RR'C=NNHCONH_2 + (CH_3)_2CO$   
Semicarbazone

From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate For directions and examples see Cheronis, pp 503-504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, J Amer Chem Soc, 41, 417 (1919)

From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate *See* Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, 52, 1267 (1930)

From the carbonyl compound and acetone semicarbazone in acetic acid See B Angla, Ann Chim Anal Chim Appl, 22, 10 (1940)

Thiosemicarbazone \*

RCHO + 
$$H_2NNHCSNH_2 \rightarrow RCH=NNHCSNH_2 + H_2O$$
  
RR'CO +  $H_2NNHCSNH_2 \rightarrow RR'C=NNHCSNH_2 + H_2O$ 

Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid For directions and examples see Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, J Chem Soc, 121, 873 (1922), W Baird, R Burns and F J Wilson, J Chem Soc, 2527 (1927), M Busch, J prakt Chem, 124, 301 (1930), P P T Sah and T C Daniels, Rec Trav Chim, 69, 1545 (1950)

Phenylsemicarbazone \*

RCHO + 
$$H_2NNHCONHC_6H_5$$
  $\rightarrow$  RCH= $NNHCONHC_6H_5$  +  $H_2O$   
RR'CO +  $H_2NNHCONHC_6H_5$   $\rightarrow$  RR'C= $NNHCONHC_6H_5$  +  $H_2O$   
Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid For directions and examples see P P T Sah and T -S Ma, J Chinese Chem Soc, 2, 32 (1934), C A, 28, 3713 (1934)

Oxime \*

RCHO + NH<sub>2</sub>OH 
$$\rightarrow$$
 RCH=NOH + H<sub>2</sub>O  
RR'CO + NH<sub>2</sub>OH  $\rightarrow$  RR'C=NOH + H<sub>2</sub>O  
Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent

For directions and examples see Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, J Amer Chem Soc, 53, 1536 (1931), W E Bachmann and C H Boatner, J Amer Chem Soc, 58, 2097 (1936), W E Bachmann and M X Barton, J Org Chem, 3, 300 (1938)

For a modification of the above method in aqueous alcohol

See W M D Bryant and D M Smith, J Amer Chem Soc, 57, 57 (1935)

From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

### EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

See: Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

See: Shriner, p. 255.

From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

See: Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, J. Amer. Chem. Soc., 53, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

See: Wild, p. 120.

Dimethone derivative (Methone derivative).\*

RCHO + 2(CH<sub>3</sub>)<sub>2</sub>C CH<sub>2</sub> 
$$\rightarrow$$
 CH<sub>2</sub>C CH HC CH<sub>2</sub>
 $CH_2$ CO  $CH_2$ 

Methone (Dimedone)

 $CH_2$ CO  $CH_2$ 

This derivative is specific for aldehydes only.

From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

For directions and examples see: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136-7; D. Vorlander, Z. Anal. Chem., 77, 241 (1929); Z. Angew. Chem., 42, 46 (1929); W. Weinberger, Ind. Eng. Chem., Anal. Ed., 3, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

See: E. C. Horning and M. G. Horning, J. Org. Chem., 11, 95 (1946).

Anhydride of dimethone derivative (substituted octahydroxanthene).\*

From the dimethone derivative with acetic anhydride.

For directions and examples see: Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

See: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, J. Org. Chem., 11, 95 (1946).

o-Dianisidine spot test.

RCHO + 
$$H_2N$$
 OCH<sub>3</sub> CH<sub>3</sub>O OCH<sub>3</sub>

$$RCH=N$$
 Schiff base (colored)

This test is usually applicable to aldehydes only.

From the aldehyde and a saturated solution of o-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

For directions and examples see: F. Feigl, Spot Tests in Organic Analysis, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, Mikrochim. Acta, 1, 55 (1927).

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

### TABLE X. ORGANIC DERIVATIVES OF KETONES

a) I iquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point *C	Melting point °C	n <mark>t</mark> ,	D;	Semi carbazone	2 4 Di nitrophenyl hydrazone	p Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	Acetone (2 Propanone)	56	-95	1 3592		190 w	126 128 vcl al	148 9 yel al	42	59	Thiosemicar bazone 179
2	3-Buten-2-one (Methyl vinvl ketone)	81		1 4095 2		141 140		,			
3	2-Butanone (Ethyl methyl ketone)	80 82	86.4	1 3791	0 804	146	116-7 115-yel al	128 9 vcl w al	oil	bp 152	Phenylsemicar bazone 168
4	3 Butyn 2-one (Fthynyl methyl ketone)	86					181	143			
5	2 3 Butanedione (Birectyl)	88 gr vcl	1 p 2 4	1 3927		mono 235 (cor) w di 278 9 c a	dr 314 5 (cor) red or PhNO	mono 230 or yel	mono 134 yel dil il di 243d yel bz	mono 76 di 245 6 (cor) 234 5 subl dil al	
6	2-Methyl 3-hutanone (Isopropyl methyl ketone)	94 3		1 3879	0 8046	113 4 112 3 tl	120 117 or vel	108 9 or yel al	oil	oil	
7	2-Methyl 1-huten-3-one (Iso propenyl methyl ketone)	97 '		1 4232 1 4235		173	181				
8	Cyclobutanone 3-Pentanone (Diethyl ketone)	100 102	39 8	1 4189 1 3922		138 9	146	144 or	oil	bp 165	
9	y-remanone (Diethy) ketone)	102	39.6	11 1922		136 9	or al	yel 50 il	()))	1 B P 10 V	
10	2 Pentanone (Methyln propyl ketone)	ני01		1 3902 1 39012	0 80639	112 106	143 4 vel or al	117	oil	bp 167	
11	1-Penten-3-one (Ethyl ymyl ketone)	י י10		1 4192			129				
12	3,3-Dimethyl-2-butanone (tert Butyl methyl ketone Pin (colone)	106	49 8	1 3960 1 3956	0 8114	157 8	125 or vcl_al fusion + [13]		oıl	75 79	
13	1-Methoxy-2-propanone (Methoxymethyl methyl ketone)	115		1 3981			163 159	111 109			
	1-Methoxy-3-butanone (1 Methoxyethyl methyl ketone)	116		1 3936		141					
15	4-Methyl-2-pentanone (Isobutyl methyl ketone)	116 8		1 3956	0 8003	132 135	95 or red al			bp 176	
	3-Methyl 2-pentanone (sec Butyl methyl ketone)	118		1 3990		94 5 pet cth	71 2			oil b p 8921	
17	1-Chloro-2-propanone (Chloro acetone)	119				150 164d	125			b р 171 <sup>73</sup>	
	2-Methyl 1-penten-3-one (Ethyl isopropenyl ketone)	119		1 4270 1		161					
19	1,1-Dichloro-2-propanone (1-1 Dichloroacctone)	120			1 305 *	163					
20	2,4-Dimethyl-3-pentanone (Di isopropyl ketone)	124		1 4001	0 8 1 0 8	160 (cor.) 149	88 85 6 or 94 8				
21	Methyl neopentyl ketone	125 122		1 401825			100				
22	3-Hexanone (Ethyln propyl ketonu)	125		1 4007	0 81491 2	113	130			bр 86 <sup>17</sup>	
23	2,2-Dimethyl-3-pentanone (tert	125 21		1 4052			144				
24	Butyl cthyl ketone)  2-Hexanone (n Butyl methyl ketone)	128	:	1 40069	0 81127	125 (cor.) 121 rapid htng	106 red or al 110	88	oil	49	Thiosemicar bazone 110

<sup>\*</sup>Derivative data given in order m.p. crystal color-solvent from which crystallized

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Sem: carbazone	2 4-Dı- nıtrophenyl hydrazone	p-Nitro- phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
25	4-Methyl-3-penten-2-one (Iso- propylideneacetone Mesityl	130		1 44397	0 86532	α 164 β 133 4,	200, red, al, 203,	132 4, or -yel,	142	β 48-9, me al	
26	oxide) 3,3-Dimethyl-2-pentanone (tert-Amyl methyl ketone)	130783		1 4100		bz	red, ac a.	al			
27	Cyclopentanone	130 7	-51 3	1 4366 1 4370	0 94869	210 203, 216-7, rapid htng	146, or ac a , 142, or - yel , al	154	55, lt pet	56 5, pet eth	
	5-Hexen-2-one (Allylacetone) 1-Methoxy-2-butanone (Ethyl methoxymethyl ketone)	132 133 <sup>757</sup>		1 4174 <sup>25</sup> 1 4063		102	108 198				
30	2,2,4-Trimethyl-3-pentanone (tert-Butyl isopropyl ketone)	135		1 4065		132				144	
31	5-Methyl-3-hexanone (Ethyl isobutyl ketone)	135735		1 407		152					
	2-Methyl-1-penten-4-one	135 45d				192					
	1-Bromo-2-propanone (Bromo-acetone)	136		1 4075		135d				36	
	2-Methyl-3-hexanone (Isopropyl n-propyl ketone) 4-Methyl-3-hexanone (sec-Butyl	136 136		1 4075		119	78				
	ethyl ketone) 2-Methoxy-3-pentanone	136 <sup>750</sup>		1 4019		120	76				
37	(Ethyl 1-methoxyethyl ketone)  Cyclobutyl methyl ketone	136		1 428328		149					
38	3-Methyl-2-hexanone	137				70					
39	3-Methyl-1-hexen-5-one	138		1 419725		112					
	1-Chloro-2-butanone (Chloro- methyl ethyl ketone)	138		1 4372							
	3-Methyl-1-penten-4-one	138				201				75 6	
	3,4-Dimethyl-2-pentanone	138		1 4094		113					
- 1	4-Hexen-3-one 2,4-Pentanedione (Acetylacetone)	139 139	- 30	1 4388 1 4465 <sup>25 6</sup>	0 976	157   mono 122,   di 209	209, yel , al			<i>dı</i> 149, al	
	2-Methylcyclopentanone 3-Ethyl-2-pentanone	139 139 <sup>746</sup>		1 4364 1 4073		184, 182 99				bp 103 <sup>22</sup>	
	3-Hydroxy-3-methyl-2-butanone (Acetyl diethyl carbinol)	140				165				87	
	4-Methyl-2-hexanone	142, 139		1 405725		120, 128					
	1-Propoxy-2-propanone (Iso- propoxymethyl methyl ketone)	142		1 4004			142 144				
	d-3-Methylcyclopentanone	143		1 434019		184 5				$\alpha 91-2, \beta 67-9$	$[\alpha]_{\rm b}^{12} + 1329$
	3,4-Dimethyl-4-penten-2-one 4-Heptanone (D1-n-propyl ketone)	144 144	- 34 0	1 4069	0 8175	114 132, pet	75, yel -			bp 193	
53	2,4-Dimethyl-3-hexanone (sec- Butyl isopropyl ketone)	145		1 4059, 1 4080		eth	or, al 71				
54	3-Hydroxy-2-butanone (d l-Acetoin)	145, 148	-72, 15	1 4178	0 9861 30	185, al , 202	di 318, or, PhNO <sub>2</sub>				Phenylosazone, 243d , yel , bz
1	d l-3-Methylcyclopentanone 1-Methoxy-3-methyl-2-butanone (Isopropyl methoxymethyl ketone)	145 <sup>755</sup> 145 <sup>748</sup>		1 4329 1 4078		185	163				

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

		<del></del>			·		<del>,</del>	<del> </del>			
No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> 20	D <sub>4</sub> <sup>20</sup>	Semi- carbazone	2 4-Dı nıtrophenyl hydrazone	p-Nitro phenyl hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
57	2,2-Dimethyl-3-hexanone (tert- Butyl n-propyl ketone)	145738		1 4107			124 116				
58	1-Hydroxy-2-propanone (Acetol)	146	~17	1 4295		196, al	128 5 (cor), or, al	173			
59	4-Chloro-3-methyl-2-butanone (α-Chloroisopropyl methyl ketone)	146		1 4390			116			í	
60	1-Hepten-4-one	146 7				110, w -al				bр 92 3 <sup>13</sup>	
	3,4-Dimethyl-3-penten-2-one 1-Ethoxy-2-butanone (Ethoxy-methyl ethyl ketone)	147 147 <sup>752</sup>		1 4506 <sup>14</sup> 1 4068		200					
63	2,5-Dimethyl-3,4-hexanedione (Di-isobutyryl)	148		1 42057						mono 125, di 172	
64	3-Heptanone (n-Butyl ethyl ketone)	148		1 4092		101, 103, 152					
	5-Methyl-4-hexen-3-one 5-Methyl-5-hexen-2-one (Meth- allylacetone)	148 149		1 4496 <sup>15</sup> 1 4285 <sup>25</sup>		163 137					
67	2-Methyl-4-heptanone (Isobutyl n propyl ketone)	150750				124					
68	4,4-Dimethyl-3-hexanone (tert Amyl ethyl ketone)	150 2				98					
69	<b>2-Heptanone</b> ( <i>n</i> -Amyl methyl ketone)	151 2	-35 5	1 40069		123, al , 127	89, yel or, al 74		207		
70	3-Ethyl-5-hexen-2-one	152		1 426025			53				
71 72	5-Hepten-2-one (Crotylacetone)  1-Methoxy-2-pentanone (Methoxymethyl n-propyl ketone)	153 153 <sup>745</sup>		1 4280 <sup>25</sup> 1 4119	0 8446	105 97					
73	3,3-Dimethylcyclopentanone	153748			ľ	178					
74	2,2,4,4-Tetramethyl-3-pentanone (D1-tert-butyl ketone)	154		1 4392, 1 4194							:
75	1-Bromo-2-butanone (Bromo- methyl ethyl ketone)	155, 5012		1 4670							
76 77	Cyclopentyl methyl ketone 2,2,5,5-Tetramethylcyclo- pentanone	155 155		1 4280	,	143					
78	1-Methoxy-3-hexanone (1-Methoxyethyl n-propyl ketone)	155746		1 4091		169, 170					
79	Cyclohexanone	156	-164	1 4507		166-7	160, 162, yel al	146 7, 90% al	81 2, 50% al	91, lgr	
80 81	4-Methyl-6-hepten-3-one 2-Hepten-4-one	156 156 7				147, w - me al	80	70	7,0		
82	2,3-Hexanedione	158				ille al				dı 175	
	3,4-Dimethyl-2-hexanone	158, 155				120, 118, 126					
	3,4-Dimethyl-3-hexen-2-one 2,2,4-Trimethyl-3-hexanone	158 158		1 447615		142 145					
86	(tert-Butyl isobutyl ketone)  2-Ethyl-1-hexen-3-one	158742		1 440818		119					
	3,3-Dimethyl-1-methoxy-2- butanone (tert Butyl methoxy- methyl ketone)	159743		1 4193							
	1-Isopropoxy-3-methyl-2-butanone 2-Methyl-3-cyclopentenone	160 161		1 4771		220	88			127	!
نــــــــــــــــــــــــــــــــــــــ					L	l	L				

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point, °C	n <sup>20</sup>	D₽º	Semi carbazone	2 4-Di- nitrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
90	1-Ethylcyclopentanone	161755				189					
	3-Methyl-2-heptanone	162		1 415		82					
	4,5-Dimethyl-5-hexen-3-one	162750				110	1				
	3,5-Dimethyl-4-heptanone (Di-	162,				83-4	i				
	sec-butyl ketone)	170-3									•
94	6-Methyl-3-heptanone (Ethyl	163,				132	1			}	
	isoamyl ketone)	160		ł	ł	ĺ	i				1
95	2-Methoxy-3-methyl-2-pentanone (sec-Butyl methoxymethyl ketone)	164757		1 4162							
96	1-Methoxy-4-methyl-2-pentanone (Isobutyl methoxymethyl ketone)	164751		1 4140							
97	2-Methylcyclohexanone	165 1, 166	-140	1 4885	0 92500	191 197d , al , rapıd	135 5 7 0, al 137	132	b р 220 <sup>35-47</sup>	43, eth	
98	4-Hydroxy-4-methyl-2-pentanone (Diacetone alcohol)	166, 164				htng	(cor) 202 3			58	3,5-Dinitro-
99	4,5-Dimethyl-4-hexen-3-one	166750				209					benzoate, 55
	2,2-Dimethyl-3-heptanone (n-	166745		1 4167		145					
•••	Butyl tert-butyl ketone)	100		1 1107		1.15					
101	2,6-Dimethyl-4-heptanone (D1-	168 0		1 417325		122, 126	66, or -			}	}
.01	isobutyl ketone, Isovalerone)	1000		1 4175		122, 120	red 92				
102	2-Methyl-4-octanone (n-Butyl	168				132					
	isobutyl ketone)										
103	2,5-Dimethyl-4-heptanone (sec-	169,				133					
	Butyl isobutyl ketone)	167									
104	d-3-Methylcyclohexanone	169		1 445621		180, me				43	$[\alpha]_{\rm D}^{12} + 13.38$
105	d l-3-Methylcyclohexanone	168, 169 6	-73 5	1 4430	0 91535	179, me	155 yel	119	94, w -al		
		109 0		1 4463		al 191 4d , rapid htng	: :				
106	1-Methoxy-2-hexanone (n-Butyl	169744		1 4173							
	methoxymethyl ketone)										
	<b>4-Octanone</b> ( <i>n</i> -Butyl <i>n</i> -propyl ketone)	170				96					
108	Methyl acetoacetate	170	-40 6	1 41964	1 0765	152					
109	2,2-Dimethylcyclohexanone	170	. 1	1 4482		201 193	140-2				
110	6-Methyl-2-heptanone (Isohexyl methyl ketone)	171 171		1 4146		154	77				
111	trans-2,4-Dimethylcyclohexanone	171		1 442916		136					
	4-Methylcyclohexanone	171 25	-406	1 4445	0 91562	199, me		128 5,	109 10,	37 9	
						al,		yel, al	al		
						203 5d,					
						rapıd					
						htng					
113	d,l-2,5-Dimethylcyclohexanone	171-3		1 4446		α 122,				111, al	
.,.	2.0	]	]	. 41610	0.01053	β 173	50 1	, J			
114	2-Octanone (Hexyl methyl ketone)	1/3	-21 5	1 41518, 1 4154	0 81853	122 3	58, or , al	92 3,			
				14134		(cor),		yel, al			
						pet eth -					
115	5-Ethyl-3-heptanone	173				134					
	d-2,5-Dimethylcyclohexanone	173-4				176 7				97 8	$[\alpha]_{6}^{20} + 116$
	3-Ethyl-2-methylcyclopentanone	174				170 /					ייי ענייין ענייין
						,					

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> 20	D <sub>2</sub> ,0	Semi- carbazone	2,4-Di- nitrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
118	2,6-Dimethylcyclohexanone	174		1 4500,							
			}	1 4470							
119	2-Isopropylcyclopentanone	174		1 439529		202			-		
120	Acetoxyacetone	174-5,		1 4150	1 0749	145 me		144, yel,	60d, eth	bp 14420	1
121	2,4-Heptanedione (n-Butyrylacetone)	741* 174 5				al		bz			Cu salt, 165 161, pa bl
122	3-Methyl-3-hepten-2-one	175	1 .		ļ	164		}	]	1	101, pa 01
	cis-2,4-Dimethylcyclohexanone	176		1 443025		200, 190	ŀ			98 9	1
	4-Ethyl-4-hydroxy-3-hexanone	178742		1 1430		177				/0 /	
	2,3-Dimethylcyclohexanone	178-9		1 4505	1	203-4	l	ł			
	2,2,6-Trimethylcyclohexanone	179767	l	1 4480		209	141	}		j	
	3,3-Dimethylcyclohexanone	179748		1 448217		219	. , ,				
	5-Ethyl-4-hepten-3-one	179740	[	1 1,102		105	[		1		
	3-Ethyl-4-methylcyclopentanone	180				208-9		l		oil, b p	
. ~ /	2 4 mem jiejeropentanone	1.55				w-al			1	117"	
130	Cyclohexyl methyl ketone	180		1 4514		177		154		60	
	trans-3,5-Dimethylcyclohexanone	d l		1 447521	d I	d1 193-4,		1.5.		d l oil.	$d [\alpha]_{D}^{20} + 4.65$
13.	inans 5,5 Dimensyleyerone autone	180 1	1	1	0 897	d 193-4.	i		l	b p	$ \begin{array}{c c} I & \{\alpha_1 \beta_1 + 4 + 6 \beta_2 \\ I & [\alpha]_D^{20} \end{array} $
		1 .00 /			d	/ 189				116-814	-791
					0 9083	' '''				1100	_ , , , ,
		[	[		1 0 9074	ĺ		[			
132	5-Hydroxy-4-octanone (Butyroin)	180-90				ľ	99				
133	Ethyl acetoacetate	181	! !			133, 129d	93		1		
134	Cycloheptanone	181,	<b>[</b>			163	148	137		23	
		182		:							
	cis-3,5-Dimethylcyclohexanone	182-3		1 4407	0 890	202 3				74	
137	2-Propylcyclopentanone	183		1 4429		214d, al				oil, b p	
120	22447	104770	١,,							109-119	
138	2,2,6,6-Tetramethylcyclohexanone	184772	15	1 4473							
139	3-Methyl-2,4-hexanedione	184			1						Cu salt, 177
140	SN	183	C - C O	1 43115	0.0000	00 -1					
	5-Nonanone (Di-n-butyl ketone)	186-7	fp-59		0 8222	90, al	1				
141	3,4-Dimethylcyclohexanone	187		1 4520	0 906	189					
	2 November (Ed. ). Named	107761		1 4507						1	
142	3-Nonanone (Ethyl n-hexyl	187751				112					
	ketone)	100.00		. 455333		1.75					
143	2,5-Dimethylcyclohexen-3-one	189 90		1 475322	[	165, me				92 3, me	
						al				al 169,	
		100	}		ļ					al	
144	Methyl 2-pyridyl ketone (2-Acetyl-	190								121	
	pyridine)					.=0.0					
145	3-Propylcyclopentanone	190-1		1 445612	1	178 9, me				oil, b p	
						al				121 212	
146	3-Ethylcyclohexanone	192		1 4537,		182, 175					
[				1 4511							
147	1,5-Dimethylcyclohexen-4-one	192-3,	İ							102	
1		194			0.0555						
148	2,5-Hexanedione (Acetonyl-	194	-9	1 428,	0 97370	mono		di 210 2	di 120,	mono	
	acetone)			1 449		185d ,	руг	red al	dıl al	b p	
ł	ľ					di 224		i		13011	
		1								di 137	
									i		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point, *C	Melting point, °C	n <sup>20</sup>	D²⁰	Semi- carbazone	2,4-Dı- nıtrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
149	d-Fenchone	195-6		1 4635518	0 94719	184, 172	140		b p 202-	d  or  l $\alpha +$ 165 $\beta +$ 123, d l $\alpha + 159$ $\beta + 129$	Hydrazone 56 7
150	2-Nonanone (n-Heptyl methyl ketone)	195 3	-8	1 42072	0 82133 0 82217	118 9 al				p+ 129	
151	1-Acetyl-4-methylcyclohexanone	195-7		1 450918		α 159, me al β 175				57 9	
152	Methyl levulinate	196 0		1 42333	1 04945	143	142, al		96 105, al		
153 154	4-Fluoroacetophenone dl-2-Ethyl-5-methylcyclo- hexanone	196 197		1 5081 <sup>25</sup> 1 4485		219 178-81				80, w -al	
	1-Acetyl-2-methylcyclohexanone	197 200				172 3					
	2-n-Propylcyclohexanone	9748		1 455813		133d , w -				67 8	
	1-Acetylcyclohexene	200		1 4892		220				59	
	3-(Trifluoromethyl)acetophenone $\beta$ -Thujone	202 202, 7610				174	114				
160	Acetophenone (Methyl phenyl ketone)	205, 202	20	1 541 1 5339	1 02810	198-9 (cor), 50% al, 203	238-40, al, 249- 50, or - red, ac a	184~5, or -red	105, wh , al , → dk	60	
	2-Ethyl-4-methylcyclohexanone Ethyl levulinate	205 <sup>747</sup> 206		1 4452 1 42288	1 01114	148	102		104		
	4-Decanone	206 7				51 2					
164	1,5-Dimethylcyclohexen-3-one -	208-9		1 481922		179-80, yel, al, 168-71			76 8		Thiosemicar- bazone, 195d
165	/-Menthone	209, 207	-66	1 4505		189, 187, 184	146, or , al	!	53	59, eth	
	<b>2-Decanone</b> (Methyl <i>n</i> -octyl ketone)	211, 2155	14, f p 3 1	1 42523	0 82370	124, 126, pet eth					
167	Methyl 4-pyridyl ketone	212								142	
	4-n-Propylcyclohexanone 2-Acetylthiophene (Methyl 2-	212 <sup>740</sup> 213	10 5	1 4514 <sup>25</sup> 1 5666		180 190, bz		181	96	81	
-170	thienyl ketone)  2-Methylacetophenone (Methyl  2-tolyl ketone)	214. 216		1 5320		205, al, 210	159, yel , al 161			61	
171	6-Bromo-2-hexanone	214720		1 4713		210	81				
	1,5,5-Trimethylcyclohexen-3-one (Isophorone)	215			0 925520 5	199 5d , al , 191			68, dıl al	79 5, pet eth , 76	
	n-Propyl 2-pyridyl ketone Propiophenone (Ethyl phenyl ketone)	217-8 218, 220	20, 18 6	1 5270	1 0105	173 4 (cor), al, 182, rapid htng	190 1, red, bz , 189		82	48 54, 53, pet eth	Picrate, 75
175	Methyl 3-pyridyl ketone	220, 218	٠.					:	137	113	
176	3-Methylacetophenone (Methyl 3-tolyl ketone)	220		1 5306	1 007	198, 203	207			55, 57, al	

 $<sup>{}^</sup>ullet$  Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sup>20</sup>	Semi- carbazone	2,4 Dı nıtrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
177	Isobutyrophenone (Isopropyl phenyl ketone)	222		1 5190	0 986316 9	181, al	163, or - red, dil ac a		73	94, lt pet	
178	Acetyi benzoyi ketone	222, yel		1 5371"		di 229 32	ac a	di 256	α 143	α, mono 166, β, mono 114 di 240	
179	5-Ethvl-1-methylcyclohexene-3- one	223 7				162 8d . al					Thiosemicar- bazone, 150 1
180	4[8]-p-Menthen-3-one (Pulegone)	224, 221 2		1 487051*		174 175 6	142			119	
181	Pivalophenone (tert Butvl phenyl ketone)	224751		1 5082 1 5102		150	194 5			167	
182	1-Phenyl-2-butanone (Benzyl ethyl ketone)	226				135 146	:				
	6-Undecanone (6-Hendecanone Di-n-amvl ketone)	(cor)	15	1 42875	0 82471	Oil				oıl	
	3-Chloroacetophenone	228				232		176	ŀ	88	
185 186	Ethvi 1-thienvi ketone 2-Undecanone (2-Hendecanone	228 228	12 1	1 42899	0 82564	167 122 0 5	63, al	90-1,		55-6 44 5	
187	Methyl n-nonyl ketone)  2,4-Dimethylacetophenone	228	12 7	1 5381		185 7		yel, al		63 4, pet	
100	2 Chl	234 5		1 5 3 4 0		1,60				eth	
188 189	2-Chloroacetophenone 1-Phenoxy-2-propanone (Phenoxy-	229 229		1 68525	1.0002	160				113	
109	acetone)	30 12019		1 5228	1 0903	173, 176 (cor), 50% al					
	n-Propyl 4-pyridyl ketone	229 31									Picrate, 96
191	n-Butyrophenone (Phenyl n-propyl ketone)	230, 218 21	11 5	1 5196 1 5203		187 8, al,	190, or - red, dil ac a			50, abs eth	
192	d-Carvone	230		1 49952	0 9608	162-3, 142-3, <i>d</i> 1-154-6	191, red, ac a	174 5, red-br		d α 72- 3, al d, β 56-7, l, α, (-) 72, l, β, (+) 57-8, d, l 93-4	[α] <sub>B</sub> <sup>20</sup> +62 9
193	2,5-Dimethylacetophenone	230	ļ	1 5291 1 5306		168 9				1 93-4	
194	4-Chloroacetophenone	232 236	12	-		204 160, 146	231	239	114	95	:
196	<b>4-Phenyl-2-butanone</b> (Methyl- β-phenylethyl ketone)	235				142				87	
197	Isovalerophenone (Isobutyl phenyl ketone)	236				210				76, 64 5	
198	3,5-Dimethylacetophenone	236 7		1 527625				179 80, yel, ac a		114, me al	
199	2-Methoxyacetophenone (2-Acetylanisole)	239, 245		1 5395	1 089	183		-	114, al	83, 96 0 5, pet	
200	3-Methoxyacetophenone (3-Acetylanisole)	240, 252		1 5583154	1 099345 4	196				. •	
	5-Phenyl-3-pentanone 5-Isopropyl-2-methylacetophenone (2-Acetyl-p-cymene)	244		1 5125 1 51849	0 965420	80 147	140 2, clearing			91-2 5	
	(2-Acctyr-p-cymene)						at 160				

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE X. ORGANIC DERIVATIVES OF KETONES a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n Zo	Dψ	Semi carbazone	2 4-Di nitrophenyl- hydrazone	p-Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
203	lpha-Bromopropiophenone	245 50		1 568625							
204	3,4-Dimethylacetophenone	246 7. 251		1 5400		233 4	}			85	
205	2,4,5-Trimethylacetophenone	246 7				204				85 6	
206	n-Propyl 3-pyridyl ketone	246 52		1 5128		169 70			182		Picrate, 104
207	n-Valerophenone (n-Butyl	248 5		1 5150	0 988 20	160, w -al	166, brt	161 5	162	52 0- 5,	
	phenvl ketone)	242					red, ac	2 5, or - red, al		pet eth	
208	2-Aminoacetophenone	250 2d	20			290d , al			108, al	109, subl. w	
209	2,5-Dichloroacetophenone	251	14							130	
210	4-Isopropylacetophenone	252 4									
211	1,1,1-Tribromoacetone	255d		l	Ì	i	İ				1
212	Ethyl benzoylacetate	265				125					
213	n-Enanthophenone (n-Hexyl phenyl ketone)	283 3	164	1 50760 <sub>He</sub>	0 95155	119, dil		127 8		55	
214	3-Phenylcyclohexanone	287 8 <sup>736</sup>			,	167, al			i	128 9, al	1
215	1-Acetylnaphthalene (Methyl 1-naphthyl ketone)	302		1 629		288 5-9 5, 232-3			146	140. 137.5	
216	Ethyl 1-naphthyl ketone	305 7		1 6109						58	Picrate, 77-8, al., 79
217	2-Benzovlpvridine (Phenvl 2-pvridvl ketone)	317		1 6056			199		136, yel ,	150 165	Picrate, 130, al
218	2,4,5-Trimethylbenzophenone	328	ĺ		1 033218				٥.		
219	2,4,4'-Trimethylbenzophenone	340								132, al	
220	α-Methylstyryl phenyl ketone	340 5			1 10820	151, bz				syn 134,	
l	(Dypnone)	sld				·				al, anti 78	
221	1,5-Diphenyl-3-pentanone (Di- benzylacetone)	352, 348	13 4							95 6	

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

### TABLE X. ORGANIC DERIVATIVES OF KETONES a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\*

No	Name	Semi- carbazone	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Miscellaneous
1	1-Chloro-2-methyl-3-pentanone	70	644			
2	4-Methyl-2-octanone	70	9440			
3	1-Hepten-5-one	82 3, w al	46 712	1 4254183	0 8487 1* 3	
4	3-Dodecanone	89 w -al	13418			m p 19
	1,3-Diethoxy-2-propanone (sym-Diethoxyacetone)	91	10535	1 4202	1	p
	1-Ethoxy-2-propanone (Ethoxyacetone)	96	362×	1 4000		
	3-Cyclopentyl-2-butanone ( $\alpha$ -Cyclopentyl- $\alpha$ -methylacetone)	98	7917	1 4470	1	
	7-Methyl-1-octen-5-one	101 2	62 314	1 428812 5		ł
9	Cyclohexyl methoxymethyl ketone	102	11121	1 455225		
10	1-Phenoxy-2-butanone (Ethyl phenoxymethyl ketone)	102	1005	1 5201		
11	1-Naphthoxyacetone	103	205 814	ļ		
12	1-Hepten-6-one	108 w -	41 310	1 435018	0 867318	
13	<b>1-Phenoxy-2-pentanone</b> (Phenoxymethyl <i>n</i> -propyl ketone)	108	1124	1 5148	İ	
14	3-Octyn-2-one	109	7615	1 444625		2.4 Dinitrophenylhydrazone 88
15	3-Hepten-6-one	109 10 wh	61 220	1 429021	0 861821	
16	3-Methyl-4-phenyl-2-butanone	112 114	13017	1 509019	1	
17	3-Methyl-3-hepten-5-one	114	82 642	1 448825		1
- 1	1-Chloro-2-ethyl-3-hexanone	115	9212		İ	
19	1,3-Dimethoxy-2-propanone (s) m-Dimethoxyacetone)	120	7818	1 4174		
21	trans-3-Hepten-2-one	125 128	60 <sup>16</sup>	1 4421	0 8445	
			ļ	1 4430	j	J
	5-Hydroxy-5-methyl-3-heptanone	125	8614	1 438614	Ì	
- 1	α-Ethoxyacetophenone	128	12215	1 5250		
	3-Propylpropiophenone (Ethyl 3-propylphenyl ketone)	128	14520			
	α-Methoxyacetophenone	129	12619	1.527035		
	1-Phenyl-4-hexen-1-one	130	971	1 527025	]	
	5-Phenyl-2-pentanone	130 131 2	122 <sup>6</sup>	1 44533		
,	2-Methyl-3-octen-6-one 1-Phenyl-1-hexen-5-one	131 2 132 et	153 510	1 545825		
	• • • • • •	ac				
	3-Phenyl-1-hexen-5-one	132	153 510	1 519325		2 4 Dinitrophenylhydrazone, 103
	4-Phenyl-2-pentanone	137	11513	1 5124	}	
1	3-Propyl-3-hexen-2-one	142	729			
ł	3-Acetylfuran	150	84 <sup>21</sup> 73 <sup>50</sup>			
	3-Hydroxy-3-methyl-2-pentanone 1-Cyclopentyl-2-propanone (1-Cyclopentylacetone)	150 150	6712	1 4200		
33	1-Cyclopenty1-2-propanone (1-Cyclopenty1acetone)	130	07			
	cts-3-Hepten-2-one	152	70 <sup>15</sup>	1 450522	0 855522	
38	3-Hydroxy-3-methyl-2-heptanone	152	8419			
	d-2-Ethyl-5-methylcyclohexanone	152 4	83 418		0 901645	[α] <sub>D</sub> +8 5
40	5-Hydroxy-2-pentanone	155	8610	1 435025		
	3-Phenyl-2-butanone	158	10722	1 5092		
1	3-Phenyl-3-hexen-5-one	158	13814	1		
- 1	Dicy clopentyl ketone	162	11212			
- 1	2-Ethylcyclohexanone	162 163	7620	1 4522		2,4-Dinitrophenylhydrazone 162
	2,3-Dimethyl-2-hepten-6-one	163	7613			
46	3-n-Propylcyclohexanone	169	4207	1 4530		
48	2-Cyclohexenone	172, 168	68 <sup>22</sup>	1 4879		2,4-Dinitrophenylhydrazone, 163
40	2-Chloropropiophenone (2-Chlorophenyl ethyl ketone)	173	10612			117
	//-1-Acetyl-3-methylcyclohexanone	174-5	99 10038			
	•			l		l
- 1	3-n-Propyl-2-cyclohexenone	175	60° 4	1 487625		2,4-Dinitrophenylhydrazone, 156

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES
a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Semi- carbazone	Boiling point °C	n 20 D	D <sub>4</sub> °	Miscellaneous
53	2-Methyl-3-butenyl phenyl ketone	177	1002 1	1 522325		
	4-Methoxycyclohexanone	178	8514	1 4560		2,4-Dinitrophenylhydrazone, 150
	5,5-Dimethyl-3-hexen-2-one	178	7940	1 4430	ļ	2, 2
	Ethyl 2-methylstyryl ketone	178	15214	1150	1	
	1	179	11811	ļ	}	
	2-Bromopropiophenone (2-Bromophenyl ethyl ketone)	179	600 3	1 4842	1	2,4 Dinitrophenylhydrazone, 155
	3-Isopropyl-2-cyclohexenone		11829	1 .		2,4 Dinitrophenymytrazone, 133
	2-Ethylacetophenone	180	ī	1 5249	ł	
	3-Pyridylacetone	185	1231		ŀ	1 118 (A 5 0 A D - 4 1 1
61	/-6-Isopropyl-3-cyclohexenone	185	98 10010	1 484		[\alpha]\frac{1}{6}^8 - 64 5 2,4-Dinitrophenyl- hydrazone, 137-8 p-Nitro- phenylhydrazone, 168-9
62	4-n-Butylacetophenone	185	14114	}	İ	}
63	3-Phenyl-2-hexen-5-one	185	13814		Į.	
	3-Ethyl-2-cyclohexenone	186	5709	1 4913	j	
	3-Methyl-3-phenyl-2-butanone	186	7715	1 5083	1	į
	2-Methyl-3-octen-5-one	187-8	68 7824	1 4748		1
	4-Isopropylcyclohexanone	188,	9113	1 4560	ł	n-Nitrophenulhydrazone 122 4
67	T-150pt opytoyctonexatione	188-9	"	1 7500		p-Nitrophenylhydrazone, 123-4
68	4,4,6-Trimethyl-2-cyclohexen-1-one	188,	73-513			
69	2-Acetyl-5-methylfuran	191	73 <sup>8</sup>			
71	3-Phenyl-2-pentanone		11018	1 5051		
72	4-Phenylhexahydroacetophenone (Methyl 4-phenylcyclohexyl ketone)	191	1211 2	İ		
73	2,6,6-Trimethylcvcloheptanone	191-2	85 512	1 456818	0 909518	
	Acetyl phenyl carbinol	194	137			2,4-Dinitrophenylhydrazone, 170 126 Oxime 113
75	2-Tetralone	194	13111	1 555525	J	m p 18, Oxime, 88
76	3-Isopropylcyclohexanone	195	511	1 4540		•
	1-Propionylcyclohexene	195, 189	10214			Oxime, 78
	$\alpha$ -Thienylacetone (1-( $\alpha$ -Thienyl)-2-propanone)	195	10612	1 536614	1	
	5,5-Dimethyl cyclohexen-3-one	195	88 532			$H_2SO_4 \rightarrow red \rightarrow vlt \rightarrow col$
	2-Acetylbiphenyl	197	1051	1		11,20,
	3-Methyl-2-cyclohexen-1-one	199, 201	7814	1 4945		2,4-Dinitrophenylhydrazone, 176
82	1-Acetyl-2,2-dimethylcyclohexene	201	11849	1 481025		
	1,1-Dimethyl-2-tetralone	204	960 5	1 538	1	
	2-Methyl-1-tetralone	205, 195	13816	1 5447		
	6-Propionyltetralin	209	16311	1 550829		1
	3-Methyl-2-n-propylcyclopentanone	210	582	1 4778		ł
	4-Methyl-1-tetralone	211	11111			
	1-Acetylcyclopentene	211	7412		1	1
	2-Acetyl-5-methylthiophene	217	832	1 5622		
	1-Tetralone	217, yel,		. 23-2		Oxime, 102, prisms, 88 9, needles, me al
91	Neopentyl phenyl ketone	218	11611	1 5078		Oxime, 114
	3-Methyl-2,5-hexanedione	220	71 10	1 4260	1	1
	cis-1-Decalone	220d	11618	1 4939		
	3-Acetylbiphenyl	223	1381	1 614025		
	1,2-Dimethyl cyclohexen-3-one	225d	118-912	1. 0. 10		
	3-Chloroacetophenone	232	11311	1 5494	]	
	3-Bromoacetophenone	233	13217	1 5755		
00	6-Acetyltetralin .	234	15610	1 559125		
	0-Acetyitetraiin 2,3-Dimethyl-2-cyclopentenone	234	136.0	1		
100	4,5-Dimenty1-2-cyctopentenone	250	72-	1 4830	1	

<sup>\*</sup>Derivative data given in order in p , crystal color, solvent from which crystallized

### TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Semi carbazone	Boiling point °C	u D	D <sub>4</sub> 0	Miscellaneous
102	1-Ethyl-2-methyl-3-cyclohexenone 3-Acetylthianaphthene 2-Oxopropionaldehyde (Methylglyoxal, Pyruvic aldehyde)	250 250 di 254	105 <sup>19</sup> 137 <sup>3</sup> 52 <sup>12</sup>			bis-2,4-Dinitrophenylhydrazone 299 300, red, PhNO <sub>2</sub> , Dioxime 157, al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE X. ORGANIC DERIVATIVES OF KETONES b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point °C	Semi- carbazone	2,4 Di- nitrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	2-Aminoacetophenone	20	250 2d	290d , al		<del></del> -	اله ,108	109, subl ,	
2	<b>2-Dodecanone</b> ( <i>n</i> -Decyl methyl ketone)	20 5	246 7	122 3 dil al				"	n <sub>D</sub> <sup>30</sup> 1 42855, D <sub>4</sub> <sup>30</sup> 0 81982
3	n-Amyl phenyl ketone (n-Pentyl phenyl ketone)	24 7	265 2	131 5, 50% al 133 (cor)	168 (cor ), ac a				n <sup>25</sup> 1 50272
	3,5-Dichloroacetophenone Benzyl methyl ketone (Phenyl-	26 27	134 6 <sup>17</sup> 216 5	199 9 5, al . 188	156	145	86 7 lgr 83	138 68 70	n‰ 1 5168
6	acetone) 4-Methylacetophenone	28	(cor ) 226	204 5, al ,	260 4 (cor), scar, ac	198	97, al	87-8, pet eth	n <sup>20</sup> 1 5348, D <sup>20</sup> 1 003
7	2-Hydroxyacetophenone	28	215	210	210 12 212 3		110	118	
8	Phorone (Di-isopropylidene- acetone)	28, yel -gr	198	221, w 186	118			48	Tetrabromide, 88 9, al
9	2-Tridecanone (Methyl n-undecyl ketone n-Hendecyl methyl ketone)	28	263	123, al , 126, 117	69, or -yel	101-2		56 7, al - pet eth	n <sub>8</sub> % 1 43175
10	Furfuralacetophenone	29, yel - red	317d		169, scar				
11 12	Ethyl 2-furyl ketone 4-Cyclohexylcyclohexanone	30, 28 30, 31 29, 2	183 100° 1	189 216	137			101 2, 104 5	
13	2-(1'-Hydroxycyclopentyl)-cyclo- pentanone	31	993					78	
14	7-Tridecanone (D1-n-hexyl ketone)	31 2	255, 264			96		!	
15	2-Acetvlfuran (2-Furyl methyl ketone)	32, 33	169-73	150, me al , 148	220	185 6, red, w - al	86, yel , w -al	104, eth - pet eth. 92	n <sup>20</sup> 1 5017, D <sup>20</sup> 1 098
16	Levulinic acid (3-Acetyl propionic acid)	33	245 6		206 (cor ), or -yel , ac a	174 5	108, bz	45-6	
17	2-Tetradecanone (n-Dodecy) methyl ketone)	33-4, dil al	ļ	115 6, al					
18	Acetylnaphthalene)	34	302	222 5 4			146	136	ng 1 6257, Picrate, 116, yel
19	1,3-Diphenyl-2-propanone (1 3 Diphenylacetone Dibenzyl ketone)	34, 35, 30	330	145 6, abs al, 125-6, dil al	100		121, al , 128 9	125, 123	
20	2,2,6,6-Tetramethyl-4-piperidone	34 9, red, dry eth, 58 (mono- hyd), eth	205~6	219 20, al				153 al	
21 22	4-Chloropropiophenone 2-Phenylcyclopentanone	36 35 37	118 <sup>2</sup> 126-7 <sup>10</sup>	177, 175 6 218d				62-3	
23 24	Furfuralacetone 4-Methoxyacetophenone	38, 39 38, 37	11610	197 8, dil al	241 (cor ) 220 (cor ), red, 231 8	195-5 5, or , al	131-2, al 142, yel, al	86-7, wh,	
25	1-Phenyl-1-hepten-3-one (n- Butyl styryl ketone)	38 9,40	159-6711		(сог)		98, yel		Dimer, 175-6

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE X. ORGANIC DERIVATIVES OF KETONES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi- carbazone	2 4-Dı nıtrophenyl- hydrazone	p Nitro phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
26	4,4-Dimethylcyclohexanone	38 41	7314	204			106 7		ng 1 4537 Dg 0 932
27	3,4-Methylenedioxypropio- phenone (Propiopiperone)	39		187 8			97	104	
28	2-Hydroxybenzophenone	39, w -al 153	250560				155, al	syn 141, bz anti 143, bz	
29	2-Methoxybenzophenone (2- Anisyl phenyl ketone)	39						145 8, dil al fu sion →	
30	3-Bromopropiophenone	40		183	}	ł		1	}
31	Benzalacetone	41	212	187	227, 223	166	157	115	Thiosemicarbazone, 148
32	1-Indanone (α-Hydrindone)	42, 38	241 2739	233 239	258	234 5, ac	130 1 134 5 me al 124 8	bz pet eth	
33	2,4-Dichloroacetophenone	42	235 40	208				152	ngo 1 5640
34	3-Aminopropiophenone	42, yel	168 915	196 7				112 112 3	N-p Toluenesulfonyl deriv 97 al
35 36	2-Bromobenzophenone 8-Pentadecanone (Di-n-heptyl ketone)	42 42	345 178					133 120	
37	<b>4-Phenyl-3-buten-2-one</b> (Methyl styryl ketone)	42	262	186, al , 198, 142	227, red, ac a 223, or - red, al	165 7, red, al	156 7 yel, al, 159	115 6, 60°, al 87	H₂SO, → or -red
38	3-Chlorobenzył phenyl ketone	43	•					102	
39	8-Acetylguanine	43 5	1160		253				[
40	2-Benzoylfuran (2-Furyl phenyl		1502					122	
41	ketone)  1.3-Dichloro-2-propanone (1,3-Dichloroacetone)	44 45	150 <sup>3</sup> 175, 173				Ę	122	n <sup>46</sup> 1 47144, D <sup>46</sup> 1 3826
42	2-Acetylquinoline	46					54		
43	3-Chloropropiophenone	46		179-80				00.1	
44	4-Bromopropiophenone	46	140²	171				90 1 63 63 5	
45	Phenyl n-undecyl ketone (n- Hendecyl phenyl ketone Laurophenone)	47, 44		94 5 95				03 03 3	
46	2-Aminopropiophenone	47, pet eth		190d, al				88 9, w	Hydrochloride, 184 5 N-Acetyl 70 1
47	Benzophenone	48, 49	306 (cor )	164-5, al, 167	238 9, or - yel, ac a, 229	154 5, yel, al, 144, red, al	137 8, al	142 3, me al , 144 140	D % 1 0976
48	2,4,6-Heptanetrione (Diacetylacetone)	49	12110	mono 203			di 142	2,6-di 68 5	ngo 1 4930, D40 1 0681
49	<b>5-Phenoxy-2-pentanone</b> (Methyl 3-phenoxypropyl ketone)	50	1212	108 10	110				
	9-Heptadecanone (Di-n-octyl ketone)	50-50 5	250-3	146	212-3,	54		111 2 89 5, 97	
51	Phenacyl bromide (ω-Bromo- acetophenone)	50, 51	225		yel , or		126		
52	4-Bromoacetophenone	51, 50 5	225	208	230, 237 (cor)		126	128, 129	
53	. ,	51, lgr	17414	163-4d , al					
54	Ethynyl phenyl ketone	51	1		214	ĺ	[		

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

# TABLE X. ORGANIC DERIVATIVES OF KETONES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi- carbazone	2 4-Di- nitrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
55	3,4-Dimethoxyacetophenone (Acetoveratrone)	51, w -al	286-8	218, w ai	206-7	227	131	140, w -ai	
56	Diphenylacetoin	52		169					4-Nitrobenzoate 84
57	Methyl 2-naphthyl ketone (2-	53 4, al,	301	234 5 237	262d, red,		176-7, 171	149, 145 6	Picrate, 82
	Acetylnaphthalene)	56	ĺ		ac a	ĺ	[	•	
58	Chloromethyl 2-phenylethyl ketone	54	244 5	156	147, 146			89	
59	2-Furyl-2-thenoylmethane	55 5	195°	1		1	l	}	Cu salt, 274
60	Phenyl 2-thienyl ketone (2- Benzoylthiophene)	56	300	195–7				93	
61	2-Nonadecanone (n-Heptadecyl methyl ketone)	56		124-5 125 5 6				77	
62	4-n-Caproylresorcinol (2 4-Di hydroxy-n-caproylbenzene)	56 7	243 5d					190-1d, 50% al	
63	2,2 -Dichlorobenzoin	57					ł	00/041	
	3-Propionylphenanthrene	57				i	1	53 6 4 7	Picrate, 113
	9-Propionylphenanthrene	57							Picrate, 107
66	Benzalacetophenone (Phenyl styryl ketone Chalcone)	58, pa yel al 57 8	345	α 168, β 170, yel, γ	244d , or - red, ac a , 245		120	140 68	Picrate, 93 7, Dimers, 124, 178, 195, 225 6
67	2-Indanone	58 58 9		179-80d 218, 212- 15 (dec )	(cor)	232 (dec )		155	-
68	Phenacyl chloride (ω-Chloro- acetophenone)	59	244	15 (dec ) 156, 149	213 4d 214 5d			89	
69	3-Phenyl-2,4-pentanedione	60	13420		214 30		ļ		Cu salt, 224
70	Mesitylacetone	60	13010	205, 197			ļ		Cu sait, 224
71	Ethyl 2-naphthyl ketone	60	312 4	202				133, w -al	
72	Difurfuralacetone	60, yel	312 7	202			121-2	155, " ui	
73	Desoxybenzoin (Benzyl phenyl ketone)	60, al	321 (cor )	148, dıl al	204 (cor ), or	163, red- br, 160	116, yel , al	98, al	
74	4-Methylbenzophenone (Phenyl 4-tolyl ketone)	60, 55	326 (cor )	121-2, al	202 4 (cor ), 199-200, or		109, wh , ac a	154, less soluble in w -ac a , 115, more soluble in w -ac a	
75	1-Phenyl-1,3-butanedione (Benzoylacetone Methyl phenacyl ketone)	61	261-2		151, pa yel, al	100-1, me al	150-3	" uc u	
76	1,1-Diphenylacetone	61, al		170			131, bz	165	
,	2,4'-Dibromobenzophenone	62, pet eth	381-4 sl d					141-2	
78	5-Isopropyl-1,3-cyclohexanedione	62							
	Benzyl 3-chlorophenyl ketone	62						120	
80	4-Methoxybenzophenone (4- Anisyl phenyl ketone)	62 4 al	354		180, dk or	198-9, al	132, 90	α 140 1, 137-8,	
ا ، ه	2 Phonulavalohovanana	62 01 60	16015	100	120			β 115 6	
	2-Phenylcyclohexanone 4-Methoxybenzil	63, al , 60 63	16015	190	139			169 124	
	1-Acetvi-2-hvdroxynaphthalene	64						1.27	Benzoate, 85 6, pyr
	11-Heneicosanone (Di-n-decyl ketone)	64, w -al						27 5	252040, 05 0, p,1
85	Benzoylformic acid (Phenylgly- oxylic acid)	66	147 5112		196 7d (cor), yel			α 127, eth,β 145d,w	Thiosemicarbazone, 188 9 (cor ), yel
86	2,2 -Dimethylbenzophenone (D1- 2-tolyl ketone)	67			190			105	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

				·	,				· <del></del>
No	Name	Melting point, °C	Boiling point, °C	Semi- carbazone	2,4-Dı- nıtrophenyl- hydrazone	p-Nitro- phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
87	1,5-Diphenyl-1,5-pentanedione (1,3-Dibenzoylpropane)	67 5, 62-3						<i>di</i> 165 6d	
88	3,5-Dibromoacetophenone	68, al, 65	19815	268d, w- ac a			109-10, yel, al		
89	Cinnamalacetone	68, eth		186, yel , al	222 3, vlt -red,		180, yel , al	153, al , 152	
					ac a, 218-20.				
					br -red, chl -me				
90	Benzoyl-2-furoylmethane	68	169³		""		l	l	Cu salt, 248
91	12-Tricosanone (Di-n-undecyl ketone Di n-hendecyl ketone, Laurone)	69 5		179		:	l.	39 40, al	
92	Diphenyl triketone	70, 69,							Heating with excess
		yel, lgr							phenylhydrazine → 4 Benzene-azo-1,3,5 tri- phenvlpyrazole, 156 7 yel -red, al
93	2-Chlorobenzyl phenyl ketone	71						86	) ye. 100, u.
94	Dihydroxyacetone	72			277 8	160		84	Diacetate, 48 Dibenzoate, 120 5, Dimer 78 81
95	3-Acetylphenanthrene	72		230				193 4	Picrate, 125 6
96	4-Methoxybenzalacetone (Anisalacetone)	73, me al			229 (cor ), red, ac a		İ	119 20	-
97	Benzylacetophenone	73	1	144	icu, ac a			87	1
98		74	1878	187					
99		74	1701	201				154-5	Picrate, 107 8
100	1-Naphthyl phenyl ketone	75 5-6 0	22515	385	α 246 7, red, β 243 4,			161	
			~		or ,				
					mixt				
101	9-Acetylfluorene	75 5			220		139		
		76, 72	13611	207			154		ļ
103	Benzyl 4-methoxyphenyl ketone	77						118	
104	4-Methoxybenzalacetophenone (Anisalacetophenone 4-	77, yel , ai		α 168, al, β 190,					Picrate, 87, or
	Methoxychalcone)			al					
105	2-Naphthoxyacetone	78, 77		203			154	123	
	4-Phenylcyclohexanone	78		212, 229d , al				110	
107 108	Benzoyl-2-thenoylmethane 4-Chlorobenzophenone	78 78	2014		185		106	β 105-6	Cu salt, 278
109		79	13220	mono	240			188	
1				221 2, di 231				l	
110	Di-n-tridecyl ketone (Myristone)	79						57	
111	Phenacyl phenyl ketone (D1- benzoylmethane, ω-Benzoyl-	keto 81, enol 78,		205			mono 105	mono 165	Dibromo deriv , 94-5, eth
	acetophenone)	al		250	220		100 111		
	3-Nitroacetophenone 4-Bromobenzophenone	81 82		257 350	228 230		128, 135 126	132 α 116-7,	
								β 110-1	
114	1-Benzoylpropionic acid	82-3d					100~4, br , bz		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE X. ORGANIC DERIVATIVES OF KETONES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2,4 Di- nitrophenyl- hydrazone	p-Nitro phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
115	Fluorenone	83, yel ,	341 5		283 4	269	151 2, yel, al	195 6 (cor)	
116	4-Iodoacetophenone	85, eth	1531×				,	(***)	
117	Di-n-Heptadecyl ketone	88 5, lgr , 89		ļ				67,62 3	
118	4,4'-Dimethylbenzophenone (Di 4-tolyl ketone)	95, al	335	143 4	218 9		100, yel , al	163, al	Hydrazone, 108 10
119	Benzil (Dibenzoyl)	95, yel	347	mono 174-5 d , di 243 4d , al	di 189, yel, al, 185	mono' 192 3, dk or, ac a, di 290, yel, pyr-eth	mono 134, yel, al, di 235, chl rapid htng	α mono 137 8, 140, bz, di 237	
3	$oldsymbol{eta},oldsymbol{eta}$ - Diphenylpropiophenone	96 92						133	
	3-Hydroxyacetophenone	96, 95	296	189 91	261	İ	Ĭ	İ	
	4-Chlorophenacyl bromide	96-8		l					Acetate, 72
123	2,3-Dihydroxyacetophenone (3-Acetylcatechol)	97 8, dk yel, bz -		166 7	ļ			96 7	Diacetate 109, bz Di-Me eth , b p 143 414
124	2-Naphthylglyoxal	lgr 98, (hyd ), w 109	18320						Diacetate, 150, bz -pet eth osazone 184
125	3-Aminoacetophenone	98-9, pa yel, al		196d , w			<u> </u>	192 4, w - al	Hydrazone, 98, al
	2-Benzoylacrylic acid	99 (anh ) 64 (mono hyd )		190			197	168d	Hydrazone, 185 6, al
- 1	Di-2-thenoylmethane	100	ĺ	ſ		Ĭ		ĺ	Cu salt, 263
	Di-1-naphthyl ketone	100					ļ	200	Picrate 121 5 2 0
129	1,3-Dibenzoylbenzene	101 2, al		1	1	1		mono 201, di 70-3	
130	2-Acetyl-1-hydroxynaphthalene	102, gr - yel, al, 98, yel,	325 sl d	245 50, pa yel			136 7, wh,dil al	168 9	Acetate, 107 5, Benzoate, 128, al
131	Cinnamacetophenone	bz 102, yel , al			222, red, ac a , 218 9d	α 135, al			
	1,3-Cyclohexanedione	104						156	
- 1	, ,	104 5						225	D . 107
	2-Propionylphenanthrene 2-Aminobenzophenone	105, 104 105-6, pa				[		156, alk -	Picrate, 107
	•	yel, al						stab, 127, a -stab	
136	Benzoylnitromethane	106					105 5 5, yel, al	96, w	
137	4-Aminoacetophenone	106, w	294	250, yel al	266 7, 263		, , ,	147 8, al	4 Toluenesulfonamide, 203
138	Benzalacenaphthenone	107, yel , w -al						48	
139	Benzyl 4-chlorophenyl ketone	108						123	
140	4-Bromophenacyl bromide	108 9						115	Acetate, 72
141	4-Hydroxyacetophenone (4-Acetylphenol)	109		199	210, br , al		151, wh → yel	145, 143 4, bz	Acetate, 54, Benzoate, 134 5, al
142	trans-1,2-Dibenzoylethylene	110			a 1		, <del>, ,</del> C1	211	134 3, 41
	Piperonalacetone	110-1, pa		α 217, al,			163	186, al	
- [	•	yel		β 168,		[			
		I .	I	bz	1	]	l	l	i

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

### TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi- carbazone	2,4-D1- nitrophenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
	2-Acetyldibenzothiophene 1,5-Diphenyl-3-pentadienone (Dtbenzalacetone)	112 112, 111		235 187-90, al	180, red, ac a	173, yel , bz	152 3, 147 8, yel, al	142 4	Picrate, 114
146	4,4'-Dimethoxybenzoin (Anisoin)	113, dıl al		185 (cor ), w -al			yei, ai		Acetate, 94-5, al -pet eth
	1,4-Diacetylbenzene 3,4-Dihydroxyacetophenone (4-Acetylcatechol)	114 116, w	130 <sup>3</sup> 127 33 <sup>11</sup>	" "				240 184d, et ac	3 4-Diacetate, 91
149	3-Hydroxybenzophenone	116, al						syn 76, anti 126, bz	
150	α-Hydroxyacetophenone (Phenacyl alcohol, Benzoyl carbinol)	117 8	11811	146 6 5, al			112, lgr - eth	70	Acetate, 49, eth., Benzoate, 118, dil al
151	7-Acenaphthenone	121 (cor ), al					90, dk , al	175, al , 183 4, bz , di 222d	Picrate, 113
152	4-Phenylacetophenone (4-Acetylbiphenyl, Methyl 4-xenyl ketone)	121, al	325-7		241 5-2, red-or			186-7, al	
153 154	Piperonalacetophenone (3,4- Methylenedioxychalcone) 9-Hydroxyxanthene (Xanthydrol)	122, yel , al 122–4d		α 203-5, abs al					Dibromide, 152, bz -lgr (1 1), Picrate, 126-8 Heat Dixanthyl ether,
155	4-Aminobenzophenone	124, w -al						168, al , 127, w - al	219, Dixanthyl, 204, Igr Hydrazone, 139–40, yel, al
	4-Phenylphenacyl bromide 2-Naphthoin	124 5 126						172	Acetate, 111
158 159	4-Phenylphenacyl chloride Vanillalacetone (4-Hydroxy-3- methoxystyryl methyl ketone)	126-7 129, yel,			230 (cor ), red		127-8, yel		Acetate, 111
160	Dianisalacetone	129, yel, bz-pet eth			82-3			147 8	
161	4,4'-Dimethoxybenzil (Anısıl)	133, yel		di 254 5, dil ac a				mono 133 syn di 217, anti, di 195, bz	Dihydrazone, 118
162	<i>d,l-</i> Benzoin	133, al , 129	344	α 205-6, w	245, yel, al, 234		α 158-9, bz-lgr, β 106	bz,β 99	Acetate, 83, al, Benzoate, 124 5, 75% al
163		134						<i>di</i> 210 1d	
164	3,4,5-Tribromoacetophenone	134 5, al		265d , ac a			129-34d, yel, pet eth		1
	4-Hydroxybenzophenone (4-Benzoylphenol)	134 5, w		194, bz	242 4 (cor ), or		144, pet eth	81, Heat → 152	Acetate, 81, al Benzoate, 94 5, 115
166	1-Furoin	135, 138-9 (cor)			216 7, or - red, al		79-81, lgr -bz	$\alpha$ 161, al, $\beta$ 102, pa yel, eth	Acetate, 76–7, Benzoate, 92 3
167 168	Mesityl phenyl ketone 4-Chlorobenzyl phenyl ketone	137 138			232			96	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## TABLE X. ORGANIC DERIVATIVES OF KETONES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point *C	Semi carbazone	2,4-Di nitrophenyl- hydrazone	p-Nitro- phenyl hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
169	α-Anisal-α'-cinnamatacetone	139, red, al					Pyrazo- line, 155 6, yel, al		Dibromide, 139-40, CS <sub>2</sub> , Tetrabromide, 155 6, CS <sub>2</sub>
170	4-Aminopropiophenone	140, w					0, 901, 41	153, al	N-Acetyl deriv 161, w
171	3,3'-Dibromobenzophenone	141	1			1	1	181 2d	
	2-Acetylphenanthrene	143		260			187 8		
173	Dicinnamalacetone	144, yel,	İ		195 7		166, yel,		Light → d
		abs al			(cor), dk red		al		
174	1,2-Dibenzoylethane	147			di 265	}	mono 116, di 179	204	
175	2,4-Dihydroxyacetophenone	147, 144		218, 214 20d	206 8		156 8	202 3	2,4-Diacetate, 38 2,4
174	(Resacetophenone)	147 8, w	1	205 6, al	l	236 7,	1	1	Dibenzoate, 81 3,5-Diacetate, 91-2, Igr
170	3,5-Dihydroxyacetophenone	147 o, w		203 0, 41		red, w -			3,3-Diacetate, 91-2, igi
					ŀ	ac a			
177	4,4'-Dichlorobenzophenone	147-8		1	238-40	ac a	1	135	į
178	1,2-Dibenzoylbenzene	148			230-70	1		mono 150	1
	9-Benzoylanthracene (9-Anthra-	148, yel,		1				130	H <sub>2</sub> SO <sub>4</sub> → brief blue color
1//	phenone)	bz		1			ļ		112504 51161 5146 65161
180	4-Hydroxypropiophenone	148		ì	229				
	5,5-Dimethyl-1,3-cyclo-	148 9						mono 115	
	hexanedione (Methone	1		J	J	ļ	1	di 176	ļ
	Dimedone)			į	}				
182	2,3,4,2'-Tetrahydroxybenzo-	149 (anh ),			1				2,3,4,2'-Tetraacetate, 118, a
	phenone	100	ļ	ļ	1		1		·
	•	(hyd),				1			
		yel , w							
183	Anthrone	154, ac a			l	1	ļ		Al sol → bl fluorescence
184	1,4-Dibenzoylbenzene	161, al						mono	
								212-3,	
		}	ļ		}		}	di 235	
185	Furil (2,2'-Bifuroyl)	165, yel,	İ		Ì		mono 82	α, mono	
		bz					3, yel ,	106, ß,	
		j		]		]	di 184,	mono	
		1					yel, lgr	97-8, α,	
		1	]	1	1			di 100,	
		}	)	J		1		166, \$,	
		Ì						di 188	
								90	
186	Benzanthrone	170, yel,	<u>}</u>	<u> </u>	j .	}	]		$H_2SO_4 \rightarrow or -red sol, gr$
		al							fluorescence
187	Quinhydrone	171, dk					152	161	
100	2.2.4 T. %	gr, subl		2264	]			142.2	3.3.4.75 0.5
188	2,3,4-Trihydroxyacetophenone	172, w	İ	225, rapid				162 3	2,3,4-Triacetate, 85
100	(Gallacetophenone)	174	250	htng			152	161	Picrate, 133
189	Xanthone (Diphenylene ketone	174	350				152	161	
190	oxide) 4,4'-Bis(dimethylamino)benzo-	174		,			174 5	233	Hydrazone, 150, Picrate,
190	phenone	1/4					114 3	233	156
191	4,4'-Dibromobenzophenone	177	395	]				150-2	Hydrazone, 92-4
	d,l-Camphor	d 1 178,	209, 205	247-8d	d, l 164,	217	233		$d [\alpha]_D^{20} + 44$ , Hydrazone,
1/4	with the second	d 179	207, 203	(cor ),	d 177,		-55		55
		" ''		236–7, al	or, al				
j			ī	1		l			
193	3-Acetylindazole	182, vel .			> 320, red.			222, bz - 1	N-Acetyl deriy, 123, ac a
193	3-Acetylindazole	182, yel, ac a			>320, red, PhNO <sub>2</sub>			222, bz - al	N-Acetyl deriv, 123, ac a
	3-Acetylindazole 3,4,5-Trihydroxyacetophenone	182, yel, ac a 187-8, w		216-7, al	>320, red, PhNO <sub>2</sub>	260d , red,		al	N-Acetyl deriv , 123, ac a 3,4,5-Triacetate, 111-2,

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Semi carbazone	2 4-Di nitrophenyl hydrazone	p Nitro phenyl hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
195	3-Acetylindole	190 l, bz						144 7, w	N-Acetyl deriv, 151, subl, pet eth -bz, Picrate, 183, yel, pet eth Diacetyl deriv, 165, 6, bz
196	2,5,2',6'-Tetrahydroxybenzo- phenone	200 2d			ĺ			}	2,5,2',6'-Tetraacetate,
197	2,5-Dihydroxyacetophenone	202, vel			İ	215 6	1	149 50,	2 5-Diacetate, 68, ac a
17.	(Ournacetophenone)	gr, w						tol	
198	2,4,5-Trihydroxyacetophenone	206 7 red			l				2 4 5-Triacetate 165 6, bz
	2,3,5-Trihydroxyacetophenone	206-7,		ļ		241 2d,			2 3 5-Triacetate, 106 7,
		yel, aca				w-al	•		lgr
200	2,4,6-Trihydroxyacetophenone (Phloracetophenone)	219, anh ,						[ 	2,4 6-Triacetate, 103, 2,4,6- Tribenzoate, 117 8
201	2,3-(3',4',5'-Triphenylcyclo- pentadieno)-indone	222					246-7		Intenzoate, 117 8
202	3,4,3'4'~Tetrahydroxybenzo- phenone	227 8, w			1			145, al	
203	Ninhydrin (Triketohydrindene hydrate)	243, 241d					di 207 8, or -red, al	201	Warm aqueous sol of α-amino acids → intense bl, vlt, etc At 125-30, loses w, turns red
204	Phenacridone	304 5, yel, ac a							N-Benzyl deriv , 188 9, yel , al

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLE XI

The derivatives of quinones are usually similar to those of ketones. Therefore, for directions and examples for their preparation see explanations and references to Tables 9 and 10, pages 141, 142, 143

The derivatives listed as phenylhydrazones, p-nutrophenylhydrazones and 2,4-dinitrophenylhydrazones of quinones in most cases are not real substituted phenylhydrazones, but either addition compounds or hydroxy derivatives of variously substituted aromatic azo compounds

#### Semicarbazone \*

$$O \longrightarrow V + H_2NNHCONH_2 \cdot HCI \longrightarrow V$$

$$O \longrightarrow NNHCONH_2 + H_2NCONHN \longrightarrow NNHCONH_2 + HC$$

$$V$$

$$V$$

$$Monosemicarbazone$$

$$Disemicarbazone$$

From the quinone with semicarbazide hydrochloride in water For directions and examples see Linstead, p 30, Vogel, p 749

#### Oxime \*

From the quinone with hydroxylamine hydrochloride in water For directions and examples see Linstead, p 30

<sup>\*</sup>Derivatives recommended for first trial

# TABLE XI. ORGANIC DERIVATIVES OF QUINONES (Listed in order of increasing m.p.)\*

No	Name	Melting point, *C	Boiling point, °C	Semi carbazone	2,4 Dı nıtrophenyl hydrazone	p-Nitro- phenyl- hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	2,3,5-Trimethyl-1,4-benzoquinone	32, yel, eth		252 3 d , yel				1-mono 181 2, yel , al 4-mono	
2	2-isopropyl-5-methyl-1,4- benzoquinone (Thymoquinone)	45 5, or - yel	232	mono 201 2d, yel, al, di 237,	mono 179 80, dk red, al		93	134, yel 1-mono 160 2, pa yel chl	
3	2,3-Dimethyl-1,4-benzoquinone (o-Xylo-p quinone) 2-Bromo-1,4-benzoquinone	55 (subl ), yel 56		yel				mono 166, yel 1-mono	
5	2-Chloro-1,4-benzoquinone	57, yel - red		4-mono 185d				184, or 4-mono 196 1-mono 184, pa grn -yel,	
6	<b>2-Methyl-1,4-benzoquinone</b> ( <i>p</i> -Toluquinone)	67 6 68 4		4-mono 178 9, yel, al di 240d,	di 269, PhNO <sub>2</sub>		130	4-mono 148d mono 134 5d w, di 220d,	
7	2,6-Dimethyl-1,4-benzoquinone (m-Xylo-p-quinone)	68 71, yel		or -red				yel -wh I-mono 175, yel , al -w 4 mono 170 1,	
8	4-Chloro-1,2-benzoquinone	78 pa yel -red, hexane						yel bz dı 128, br	
9	2,5-Dimethyl-1,4-naphthoquinone	94 yel					mono 226,		
10	Dunnione	me al 98 9, or - red, w		mono 232 3, w -me al	266 8, or		red, ac a		$[\alpha]_{\mathrm{B}}^{\mathrm{Is}}$ +310° in chl
11	2-Methyl-1,4-naphthoquinone	106, yel, me al		ai	4- <i>mono</i> 299d			mono 160, di 166-8	Benzoyi chloride + Zn dust → 1 4-dibenzyloxy- 2-methylnaphthalene, 180 0-0 5, coł, ał
12	Quinone (1,4-Benzoquinone)	116, yel 113		mono 166, yel, 165- 6d, red, 178, di 243d, red	mono 185 6, br, al, di 231		152	240	Picrate, 79, Quinhydrone,
13	2-Chloro-1,4-naphthoquinone	117, yel , w		reu				4-mono 200 d 198, pa yel, bz	
14	1,4-Naphthoquinone (α-Naphthoquinone)	117 8, yel, al		mono 247, grn-yel, ac a	mono 278, yel, pyr	mono 277 9, or -red, PhNO <sub>2</sub>	mono 205-6d , dk vlt , bz		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XI. ORGANIC DERIVATIVES OF QUINONES (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Semi- carbazone	2,4 Dinitro- phenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
15	2,5-Dimethyl-1,4-benzoquinone (p-Xylo-p-quinone)	125, yel , al					122 4, yel, 154 5, or	mono 168, yel, w, di 272, yel, al,	Monobenzoylphenyl- hydrazone, 122 4, yel , lgr
16	2,6-Dibromo-1,4-benzoquinone	131, yel , al		4-mono 225d, yel, al				254 4- <i>mono</i> 170d , br	
17 18	2,6-Diphenyl-1,4-benzoquinone 2,5-Dihydroxy-3-n-dodecyl-1,4- benzoquinone (Embelin)	137 8, red 143, or - red, eth - bz		di 236		•	di 189 90	242-4d tetra 175	Diacetate, 54 Dibenzoate, 97-8
19	<b>1,2-Naphthoquinone</b> (β-Naphthoquinone)			1-mono 184d , yel , al		1-mono 250 1, 2-mono 236, dk red, ac a	2-mono 138, dk red, al	1-mono 109 5, 2-mono 162-4d, di 169, yel, al	
	3,7-Dimethyl-1,2-naphthoquinone	red, al						2- <i>mono</i> 222d , or	
21	5-Hydroxy-1,4-naphthoquinone (Juglone)	153 4, or , bz						mono 167 0 7 5, red, ac a , di 225 (exp), dk br, ac a	Acetate, 154-5
22	3-Chloro-1,2-naphthoquinone	172, red, chl						1-mono 167 8, or	
23	1,8-Dihydroxy-2-methyl-9,10- anthraquinone (2-Methylchry- sazm)	175							Diacetate, 205
24	2-Methyl-9,10-anthraquinone	177 9, 177, pa						:	Diacetate, 217, pa yel, ac a
25	3,5-Dihydroxy-2-methyl-1,4- naphthoquinone (Droserone)	yel 181, pa yel, al						di 151	Diacetate, 119, me al
26	2,3,4-Trihydroxy-9,10-phenan- thraquinone	185d , br - red		mono 270d , br -red, al					Phenazine, 255d, br, al
27	6-Bromo-1,4-dihydroxy-9,10- anthraquinone (6-Bromo- quinizarin)	185 5, red- br , bz		<u></u>					Di Me eth , 176 5, or - yel , al , Diacetate, 220 5, yel , al
28	1,2-Anthraquinone	185 90d , or -br		i				1-mono 188d , or -br , 2-mono 200d , or -br	220 3, you, al
29	4-Chloro-1,2-naphthoquinone	188, red br , bz						2-mono 157, pa yel	
30	7-Isopropyl-1-methyl-9,10- phenanthraquinone (Retene- quinone)	197, or , al		mono 200, yel , pyr		mono 222 3, red, ac a	mono 160, or , bz -al	mono 128 5, 130 1 (cor), yel, al	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### TABLE XI. ORGANIC DERIVATIVES OF QUINONES

(Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi- carbazone	2,4 Dinitro- phenyl- hydrazone	p-Nitro- phenyl hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
31	Camphorquinone	199, yel , dıl al		3 mono (α) 236d , al	mono 36, di 190	239	183 90, pa yel, al,170	mono α 153 β 114 5, di (four forms) α 201d, β 248d, γ 136 δ 194d	3-p-Bromophenylhydra- zone, 215 6, ac a , Hy- drazone, 182
32	1-Hydroxy-9,10-anthraquinone	200, or - red, al, 193	subl						Acetate, 176 9, yel, al
33	1,4-Dihydroxy-9,10-anthra- quinone (Quinizatin)	200 2 (cor), red, ac a, 195							Diacetate, 207 8, yel, pyr, 200-1, yel, ac anh
34	9,10-Phenanthraquinone	206 7 5, or -yel, 208, or	>360, subl → or -red	<i>mono</i> 220d	mono 312-3d, dk red	mono 245, red, xyl	mono 165, dk red, al	mono 158, grn - yel , al , di 202d	Conc H <sub>2</sub> SO <sub>4</sub> → dull grn
35	1,4-Anthraquinone	218d, yel, turns dark at 200 10						233 br , turns dark at 205	
36	4-Chloro-1,2,3-trihydroxv-9,10- anthraquinone	233, yel							Triacetate, 187, yel, Conc H <sub>2</sub> SO, → red
37		233 4, red-yel, ac a						mono 163 4, or	
38	1-Bromo-9,10-phenanthraquinone	233-4, yel						mono 213d	
39	Chrysoquinone (Chrysenequinone)	239 5, red						<i>mono</i> 161, or	Conc H <sub>2</sub> SO <sub>4</sub> → bl
40	1,2,8-Trihydroxy-9,10-anthra- quinone (2-Hydroxychrysazın)	239 40, red, ac a							Triacetate, 224, yel 2-Me eth, 220 or, chl-me al, 2,8-Di-Me eth, 193, br - yel, chl-me al, 1,2,8-Tri-Me eth, 157, yel, me al
41	1-Amino-9,10-anthraquinone	251, or - red							N-Acetyl, 218, or -red, N-Benzoyl, 255, grn, N-p-Toluenesulfonyl, 228 9
42	3-Amino-9,10-phenanthraquinone	254, dk red-br , al						mono 247d , red-br	
43	1,2,4-Trihydroxy-9,10-anthra- quinone	259, dk red, abs al						icu-ui	2-Me eth 232 3, red, bz, 2,4-Di-Me eth 186-9, or, 2-Acetate, 179 80, or, al Triacetate, 198- 200 (sinters 193), pa yel
44	Acenaphthenequinone	261 (cor ), yel , ac a		mono 192-3, ac a, di 271, al		mono 247, or - red, ac a	mono 179, or - red, al, di 219, dk yel, al	mono 230, dil al , 220d	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE XI. ORGANIC DERIVATIVES OF QUINONES (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, *C	Semi- carbazone	2 4-Dinitro- phenyl hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
45	1,3-Dihydroxy-4-methyl-9,10- anthraquinone (4-Methylpur- puroxanthin)	265 6, or , bz							Di-Me eth, 162, yel, chl, Diacetate, 181-2, yel, ac a
46	2-Bromo-1,4-dihydroxy-9,10- anthraquinone (2-Bromo- quinizarin)	265 8, br - red							Diacetate, 226-9, yel
47		268 dk - yel,ac a		<i>mono</i> 242d			<i>mono</i> 177, red	mono 198, di 212d, grn	
48	Aceanthrenequinone (3,4- Benzacenaphthenequinone)	270, red, bz					mono 203, or , bz	mono 251d, yel, ac	subl
	1,2,5-Trihydroxy-9,10-anthra- quinone (Hydroxyanthrarufin)	273 4, red, ac							2-Me eth , 229, yel , al , I 2-Di-Me eth , 231, or , al , 1,2,5-Tri-Me eth , 203 4, yel , al , Triacetate, 228 9, yel al
50	1,5-Dihydroxy-9,10-anthra- quinone (Anthrarufin)	280 (subl), pa yel	379-81					:	Diacetate, 245d, pa yel, ac a
51	Chloranilic acid (2 5-Dichloro- 3,6-dihydroxy-1,4-benzo- quinone)	283 4, red, w (+2H <sub>2</sub> O)							Di-Me eth, 141 2, red, Di-Et eth, 107, red, Di- acetate, 182 5, yel
52	9,10-Anthraquinone	286	382, 376 8 (cor)					mono 224, pa yel, (rapid htng)	Diacetate, 260, col, ac a
53	Chloranil (2,3,5,6-Tetrachloro- 1,4-benzoquinone)	290, yel, ac a, (slow htng, sealed tube)	subl						SO <sub>2</sub> —Tetrachlorohydro- quinone, In w -alkali sol → alkali salts of chloranilic acid
54	Alizarin (1,2-Dıhydroxy-9,10- anthraquınone)	290, or ,	430						2-Benzoate, 214 6, al, 2-p-Bromobenzoate, 195, yel, Diacetate, 184, yel, al, Di-Me eth, 215
55	2-Amino-9,10-phenanthraquinone	> 300, dk vlt, w, sinters at 205-10							N-Acetyl, 324, dk red-vlt, PhNO <sub>2</sub> , N-Benzoyl, 297-8, br -red, PhNO <sub>2</sub>
56	3-Aminoalizarin (3-Amıno-1,2- dıhydroxy-9,10-anthraquınone)	> 300, dk red, ac a							N-Acetyl, 238-40, yel -br, Monobenzoyl, 275, dk yel, Dibenzoyl, 252, yel
57	1,4-Diamino-5,8-dihydroxy-9,10- anthraquinone (5,8-Diamino- quinizarin)	>300, br - vlt , PhNO <sub>2</sub>							N,N'-Dibenzoyl, 284-5, br -vlt, xyl, N,N'-Di- phenyl, 258-60, dk bl, bz -lgr, 1,4-Di-Me eth, 250d, vlt -blk, ac a
58	Dianthraquinone (9,9'-D1- anthranyl-10,10'-quinone)	>300, yel							Conc $H_2SO_4 \rightarrow vlt$ -red, $CrO_3 \rightarrow Anthraquinone$ , $Zn dust + ac a \rightarrow di$ - anthranol, 230 (enol), 250 (keto)

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### TABLE XI. ORGANIC DERIVATIVES OF QUINONES (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, *C	Boiling point, *C	Sem: carbazone	2 4-Dinitro- phenyl- hydrazone	p-Nitro- phenyl- hydrazone	Phenyl- hydrazone	Oxime	Miscellaneous
59	2-Amino-9,10-anthraquinone	306, 303 6, red, al							N-Acetyl, 262, yel, N,N-Diacetyl, 258, yel, ac a N-Benzoyl, 227 8, yel, ac a
60	2-Hydroxy-9,10-anthraquinone	305, yel , al	306						Acetate, 159 60, al , Benzoate, 202 4, ac a
61	1,2,3-Trihydroxy-9,10-anthra- quinone (Anthragallol)	313 4d , br -or (290, subl )							Triacetate, 181 2, yel, al 188 9, pyr 2,3-Di-p-toluenesulfonate 196 8, yel, pyr, Tri-Me eth, 167 9, grn -yel, bz -pet, Triacetate, 181-2, yel, ac a, Tribenzoate, 213 5, pa yel, al bz
62	1,2,6-Trihydroxy-9,10-anthra- quinone (Flavopurpurin)	>330, (>160, subl)							2,6-D1-Me eth , 239, yel , 1,2,6-Tr1-Me eth , 225-6, yel Diacetate 238 Tr1 acetate 202 3
63	1,2,7-Trihydroxy-9,10-anthra- quinone (Anthrapurpurin)	369, or , al							2-Acetate, 296-8 yel, al, 2,7-Diacetate, 192-3, yel, al-ac a Triacetate, 223, pa yel, ac a Tri-Me eth, 201, yel, al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or via the acyl halide. All of them appear therefore under the same title

Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid

$$RCOCI + H_2O \longrightarrow RCOOH + HCI$$
 $Acid$ 
 $(RCO)_2O + H_2O \xrightarrow{NaOH} 2RCOONa \xrightarrow{H^+} RCOOH$ 

From the acyl halide in water

For directions and examples see Wild, p 180

From the acyl halide with aqueous sodium hydroxide

See Vogel, p 369, Wild, p 180

From the acid anhydride with water

See Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, J Chem Soc, 97, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

See Linstead, pp 16 7 Wild, p 184

Amide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{NH_3}$  RCONH<sub>2</sub> + NH<sub>4</sub>CI  $\xrightarrow{A_{Cld}}$   $\xrightarrow{A_{Cld}}$   $\xrightarrow{Chloride}$  RCOOH + NH<sub>3</sub>  $\longrightarrow$  RCONH<sub>2</sub>  $\xrightarrow{RCONH_2}$   $\xrightarrow{A_{mide}}$ 

Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia

For directions and examples see Cheronis, p. 440, Shriner, p. 200, Vogel, p. 361, Wild, p. 181

From the acid chloride in benzene with aqueous ammonia

See D Swern, J M Stutzman and E T Roe, J Amer Chem Soc, 71, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

See Linstead, p 14, Wild, p 182

From the neat acid with gaseous ammonia

See J A Mitchell and E E Reid, J Amer Chem Soc, 53, 1879 (1931)

From the acid anhydride with aqueous ammonia

See Wild, p 184, 185

Anılıde \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{C_6H_5NH_2}$  RCONHC<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NH<sub>3</sub><sup>+</sup>Cl<sup>-</sup>  
RCOOH + C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>  $\longrightarrow$  RCONHC<sub>6</sub>H<sub>5</sub> + H<sub>2</sub>O  
(RCO)<sub>2</sub>O + C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>  $\longrightarrow$  RCONHC<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NH<sub>3</sub><sup>+</sup>RCOO<sup>-</sup>

From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether *For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

See Wild, pp 181, 219

From the acid and aniline at high temperatures

See Vogel, p 362

\*Derivatives recommended for first trial

#### EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

From the acid anhydride with aniline without solvent

See Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

See Linstead, p 15, Wild, p 185

p-Toluidide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{p\text{-CH}_3C_6H_4NH_2}$  RCONHC $_6H_4CH_3$ - $p$  +  $p\text{-CH}_3C_6H_4NH_3$ + $^+Cl^-$   
RCOOH +  $p\text{-CH}_3C_6H_4NH_2$   $\longrightarrow$  RCONHC $_6H_4CH_3$ - $p$  +  $H_2O$   
(RCO) $_2O$  +  $p\text{-CH}_3C_6H_4NH_2$   $\longrightarrow$  RCONHC $_6H_4CH_3$ - $p$  +  $p\text{-CH}_3C_6H_4NH_3$ + $^+RCOO^-$ 

From the acid chloride with p-toluidine in ether or benzene

For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and p-toluidine at high temperatures

See Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, p-toluidine and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

From the acid anhydride with p-toluidine without solvent

See Cheronis, p 459, Linstead, p 17

From the acid anhydride with p-toluidine in benzene

See Wild, p 185

1- and 2-Naphthylamide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{1- \text{ or } 2 \text{ } C_{10}\text{H}_7\text{NH}_2}$  RCONHC<sub>10</sub>H<sub>7</sub> + C<sub>10</sub>H<sub>7</sub>NH<sub>3</sub><sup>+</sup>Cl<sup>-</sup>

Naphthylamide
(1 or 2-)

From the acid chloride with the naphthylamine

For directions and examples see Cheronis, p 446, P W Robertson, J Chem Soc, 115, 1210 (1919)

p-Nitrobenzyl ester \*

RCOONa + 
$$p$$
-NO<sub>2</sub>C<sub>6</sub>H<sub>4</sub>CH<sub>2</sub>X  $\rightarrow$  RCOOCH<sub>2</sub>C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub>- $p$  + NaX (X = Cl, Br, I)

From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol *For directions and examples see* Cheronis, pp. 447, 448, Shriner, p. 200, Vogel, p. 362, Wild, pp. 144. 5 From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

See F F Blicke and F D Smith, J Amer Chem Soc, 51, 1947 (1929)

From the sodium or the potassium salt of the acid and p-nitrobenzyl bromide in 1 2 water-ethanol See E Reid, J Amer Chem Soc, 39, 124 (1917)

From the sodium or the potassium salt of the acid and p-nitrobenzyl chloride or iodide in 1 2 water-ethanol

See J A Lyman and E E Reid, J Amer Chem Soc, 39, 701 (1917)

p-Bromophenacyl ester \*

RCOOH + 
$$p\text{-BrC}_6\text{H}_4\text{ COCHN}_2$$
  $\xrightarrow{\text{CuCl}_2}$  RCOOCH $_2\text{COC}_6\text{H}_4\text{Br-}p$  +  $N_2$ 
 $p$  Bromodiazoaceto-
phenone  $p$ -Bromophenacyl ester

From the sodium salt of the acid and p-bromophenacyl bromide in aqueous ethanol

<sup>\*</sup>Derivatives recommended for first trial

#### EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with p-bromophenacyl halide in 1 2 water-ethanol

See W L Judefind and E E Reid, J Amer Chem Soc, 41, 1043 (1920)

phenone

From the sodium salt of the acid (neutralization with sodium hydroxide) with p-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, J Amer Chem Soc, 52, 818 (1930), C G Moses and E E Reid, J Amer Chem Soc, 54, 2101 (1930)

From the acid and p-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, J Amer Chem Soc, 73, 5301 (1951)

p-Phenylphenacyl ester \*

From the sodium salt of the acid (neutralization with sodium carbonate) and p-phenylphenacyl bromide in aqueous alcohol

For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, J Amer Chem Soc., 52, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and p-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, J Amer Chem Soc, 54, 2059 (1932)

For dibasic acids from the acid, ethylamine and p-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, J Amer Chem Soc, 54, 2059 (1932)

From the acid and p-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, J Amer Chem Soc , 73, 5301 (1951)

Methyl ester

RCOOH + CH<sub>3</sub>OH 
$$\xrightarrow{\text{H}_2\text{SO}_4}$$
 RCOOCH<sub>3</sub> + H<sub>2</sub>O  
RCOOH + CH<sub>2</sub>N<sub>2</sub>  $\xrightarrow{\text{RCOOCH}_3}$  + N<sub>2</sub>  
Methyl ester

From the acid with methanol and a catalytic amount of sulfuric acid

For directions and examples see Linstead, p. 16, Vogel, p. 383

From the acid and diazomethane in ether

See B Eistert, in Newer Methods of Preparative Organic Chemistry, Interscience, New York, 1948, p 513

Ethyl ester

From the acid and ethanol in the presence of a catalytic amount of sulfuric acid For directions and examples see Vogel, pp 383, 385, 386, 387
From the silver salt of the acid with ethyl iodide
See Vogel, p 388

<sup>\*</sup>Derivatives recommended for first trial

#### EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

S-Benzylthiuronium salt.\*

RCOONa + 
$$[C_6H_5CH_2SC(NH_2)_2]^+Cl^- \rightarrow [C_6H_5CH_2SC(NH_2)_2]^+RCOO^- + NaCl$$
  
S-Benzylthiuronium chloride S-Benzylthiuronium salt

From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, Bull. Soc. Chim. [5], 5, 1153 (1938), S. Veibel and K. Ottung, Bull. Soc. Chim. 6, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, J. Amer. Chem. Soc., 58, 1004 (1936).

Phenylhydrazide.

RCOOH + 
$$H_2NNHC_6H_5$$
  $\rightarrow$  RCONHNHC<sub>6</sub> $H_5$  +  $H_2O$   
Phenylhydrazide

From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, J. Amer. Chem. Soc., 64, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

<sup>\*</sup>Derivatives recommended for first trial.

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling paint, °C	Melting point, °C	л <mark>D</mark>	D4º	p- Tolui dide	Anilide	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	Thioacetic acid	93			1 074¦0	130	76		108			
2	Formic acid	100 7	8 4	1 37137	1 22026	53	50	140 135				p Nitrobenzyl ester, 31
3	Acetic acid (Ethanoic acid)	118 2	166	1 36976 1 3721	1 04926	153 147	114	86 0	82			p-Nitrobenzyl ester, 78
4	Difluoroacetic acid	134 5		, , , ,					52			
5	Acrylic acid	141, 140	13	1 4224	1 062116	141	104 5, w		84-5, pet eth			
6	Propionic acid (Propanoic acid)	141	20 8	1 3868	0 99336	126, 123	106	63 4	81		,	p-Nitrobenzyl ester 31
7	Propiolic acid	144d	18		1 13915		87		61 2			
8	Isobutyric acid (Isobutanoic acid)	154 7	-46 l	1 3920	0 94791	108 5 9 5	105	76 8	128 129			
9	Methacrylic acid	161	16	1 429	1 015				102 6			p-Bromoanilide,
10	n-Butvric acid (n-Butanoic acid)	162 5 164	-5 5 -8	1 3983 1 3979	0 95790	75	96 97	63	115 6			p Nitrobenzyl ester, 35
11	Pyruvic acid (α-Οχοργοριοπίς acid)	165d 80 <sup>25</sup>	13 6	1 4138	1 266815	109 130	104, subl		124 5, 145			2,4-Dinitro- phenylhydra- zone 218, yel,
12	Vinylacetic acid (3-Butenoic	169 163	-35	1 4221	1 0094		58		73			al
13	acid)  Isocrotonic acid (cis-(β)-  Crotonic acid cis-2-	169	15	1 4456	1 0265	132	101 2	81	101 2			
	Butenoic acid)											
14	d /-2-Methylbutanoic acid	176 7		1 4052	0 93820	92 5	110	55	112			
15	(Ethylmethylacetic acid)  Isovaleric acid (3-Methyl- butanoic acid)	174 176 5	-300	1 4043	0 92623	106 7	109 5 (cor)	68 0	135 137			
16	n-Amylpropiolic acid (1- Heptyne-1-carboxylic acid)	180 220d	fp 2 5		:	68, bz	(68.)		91			Nitrile, b p 194 6 o-Toluidide, 60, pet eth
17	3,3-Dimethylbutanoic acid (tert-Butylacetic acid)	184, 96 <sup>26</sup>	67	1 4096	0 9124	134	132, et ac - pet eth		132	b p 126		00, per 0111
18 19	d l-α-Chloropropionic acid Cyclopropanecarboxylic acid	186 186, 182 4	17, 18-9	1 43901	1 0885	124	92		80 125		b p 134, n <sup>60</sup> 1 41902, D <sup>15</sup> 0 96078	
20	n-Pentanoic acid (n-Valeric acid)	186 4	- 34 5	1 4086	0 93922	74	63	75	106		0 70070	
21	2,2-Dimethylbutanoic acid (Dimethylethylacetic acid)	187, 190	-150	1 4141, 1 4145	0 9276	830 5	92, 90-1		103			p-Phenylphenacyl ester, 86
22	Allylacetic acid (4-Pentenoic acid)	188 9		1 4341	0 98434*				94, b p		bр 144-6	·
23	Cyclopropylacetic acid	190750		1 432025					230			p-Phenylphenacyl ester, 83
24	d 1-2,3-Dimethylbutanoic acid (Isopropylmethylacetic acid)	191 7	-15	1 4146	0 9275	112 6	78 4		132			p-Phenylphenacyl ester, 74
25	Dichloroacetic acid	194	5-6	1 4659	1 5634	153	118	99	98, subl			

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	п <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	p- Tolui- dide	Anılıde	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
26	Cyclobutanecarboxylic acid	195	1 440325	1 0599		-			152 3	bр	bр	
ĺ										136 0 5	159 62	
27	2-Ethylbutanoic acid	195	-318	1 4132	0 9239	1162	127 5		112 107			
28	(Diethylacetic acid)  d l-2-Methylpentanoic acid	195 6		1 4136	0 9230	81	95		79 6			
-	(Methyl-n-propylacetic acid)	.,,										
•	d,l-3-Methylpentanoic acid	197 5	-416	1 4159	0 9262	74 8	87, 88		124 9			
30	4-Methylpentanoic acid (Iso caproic acid, Isobutylacetic acid)	199 1752	-33	1 4144	0 9225	63 0	112 0, 110 5	77 3	120 1			
31	Methoxyacetic acid (Glycolic acid methyl ether)	204, 203		1 41677	1 1768		58, pet eth		96 5 7 0, 92-4			
32	2-Ethyl-2-methylbutanoic acid (Diethylmethylacetic acid)	204		1 4256					78			
33	Hexanoic acid (n-Caproic	205 35	-39,	1 41635	0 93568	74 5	94 5	72 0	100,	l	Ър	
	acid)		f p -15-						101		166-7	
		206.7	-2	1 41027	1 1021	22 -45	06 02	104.0	80-2		i	:
34	Ethoxyacetic acid (Glycolic acid ethyl ether)	206 7		1 41937	1 1021	32, eth		104 8				
35	5-Methylhexanoic acid	207752		1 4220		1.20	75		103		ļ	
36	2-Ethylpentanoic acid (Ethyl-n-propylacetic acid)	209				129	94		104 3	1		
37	2-Methylhexanoic acid (n- Butylmethylacetic acid)	209 6		1 418925		85	98		73 70- 2 5			
38	$\alpha$ -Chloroisovaleric acid	20-2									b p 178 9	Nitrile b p 154 5 Chloride, b p 149
<b>3</b> 9	α-Bromobutanoic acid	217d				92	98		112, 108			O P 113
40	4-Methylhexanoic acid	217 8754		1 4211	0 9194	}	76 5		98			
41	2,2-Dimethylhexanoic acid	218		Ì		]			89			
42	4-Ethyl-4-methylbutanoic acid (active-Amylacetic acid)	221			0 9149					b p 158 64	b p 173 9	[α]½ +76 in me al
43	2-Chloro-n-valeric acid (2- Chloropentanoic acid)	222								ь р 160	b p 185-6	Nitrile, bp 160
44	n-Heptanoic acid (n-Heptoic	223 0	-7 46	1 4234	0 91808	81	70, 65	72 0	96, 96.5			
<b>4</b> 5	acid) 2-Ethylhexanoic acid (α-Ethylcaproic acid)	228							102			p-Phenylphenacyl ester, 53 4, 49 5 50
46	Cyclohexylacetic acid	237		ļ					172	İ		
	n-Caprylic acid (n-Octanoic acid)	237, 239 3	16 3	1 4268	0 90884	70	57	67 4	110, 106		b p 207 8 <sup>754</sup>	
48	Pelargonic acid (n-Nonanoic acid)	254 4	12 3	1 43446 <mark>#e</mark> , yel	0 90552	84	57	68 5	99			
49	d-Citronellic acid (2,6-D1- methyl-1-octene-8-carboxylic acid)	257			0 9308				84 5		b p 113 5 <sup>12</sup> , [α] <sup>16</sup> +0 3	[ $\alpha$ ] <sub>D</sub> +21, Nitrile, b p 230, D <sup>20</sup> 0 8645
50	2-Phenylpropionic acid	265		İ					92	1		
51	4-Acetylbutanoic acid (γ- Acetobutyric acid)	275d , 195– 200 <sup>65</sup>	13-4			123, w			chl			Semicarba- zone 175d (+1 H <sub>2</sub> O), w, Oxime, 104 5 bz

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing amide m.p.)\*

No	Name	Amide	Boiling point, *C	Melting point, °C	n <sub>D</sub> 20	D₹º	p- Tolui- dide	Anilide	p-Bromo- phenacyl ester	Methyl ester	Ethyl ester	Miscellaneous
1	3-Ethoxypropionic acid	51	12017		1 4216		-	<u> </u>				
2	3-Heptynoic acid	67	102²	14	1 463525		İ					
3	2-Heptynoic acid	68 9, al	13520	i	1 4619	0 978	ł	ľ	i	bp 91-		1
	_	1				ļ				319, n <sup>20</sup>		
					ł	}	1			1 4455,		
		l					İ	l		D <sub>4</sub> <sup>20</sup>	1	
									1	0 937		
4	trans-Oleic acid	75-6	216 <sup>5</sup> , 250 (super-	α 13 36, β 16 25	1 4597		42 5	41	40, 46			
			heated steam)									1
5	2-Fluoropropionic acid	76	608			ĺ						
	2-Azidoisovaleric acid	78 9.	8201			1 063833					bp 8216,	
·	(2-Triazoisovaleric acid)	bz	-								D <sub>20</sub>	
											1 0295	Ì
7	d,l-Lactic acıd	78 5 9 0	12215	18			107	58 5-	1128	144 8	154	
		(cor),						90,				
		bz -al			<b>!</b>			w			1	
		(3-1)										
8	d 1-2-Azidopropionic acid	80, bz	121 520								bp 7016	Explodes on
	(d,l-2-Triazopropionic										n <sub>D</sub> <sup>25</sup>	heating
	acid)										1 428 57,	
1											D <sub>23</sub> <sup>23</sup>	
ا	2 Pd-4 2 House to 14	00	12210								1 065	
	2-Ethyl-3-Hexenoic acid	80 80	13219								1	
	4-Phenoxybutanoic acid 2-Methoxypropionic acid	81	8910									
	/-Citronellic acid (2,6-Di-	84-5	117 90 6		1 456324	0 927425	93_4	76		bp 8611		$[\alpha]_{b}^{24} - 66$
'-	methyl-1-octen-8-car-	04.5	''''		1 4303	0 727425	/3 4	/0		0 p 00		
	boxylic acid)											
13	2-Ethyl-4-methylpentanoic	89	11520								1	
	acid (Ethylisobutylacetic										1	
	acıd)											
14	2-Octynoic acid	90	13310		1 4595	,		60				
15	6-Methyloctanoic acid	91	14923		1 4337							
, ,	2 Made II	00	1.1316		1 4222							
- 1	3-Methylhexanoic acid	98	11216		1 4222				ł		1	
	2,3-Dimethylpentanoic acid 2-Cyanopropionic acid	102 105, 81	92 <sup>15</sup> 142-5 <sup>11</sup>								bp 192-3	
	7-Methyloctanoic acid	105, 81	1052								ор 192-3	
	1-Chlorocyclohexane		138–4013									Ethylamide, 53
	carboxylic acid	al -w	.50 10									2-11,10.11100,33
22	2-Cyanobutanoic acid	113	153-515								bp 207-9	
	Methylneopentylacetic acid		10814					l			•	
24	2-Isopropylbutanoic acid	135	10515									
- 1	(2-Ethyl-3-methylbuta-	ĺ										
	noic acid)											
25	5-Cyclopentylpentanoic	136	1234 5					,	İ			
	acid											
26	2-Methylcyclopentane-	148	1079		1 450422				-			
,,	carboxylic acid	167	004		1 42302			İ	ļ			
2/	3,4,4-Trimethylpentanoic acid	167	984		1 432021				I			
20	acid cis-4-Methylcyclohexane-	175	13013					ļ	}			
20	carboxylic acid	1/3	130						ļ			
- 1	Cyclopentanecarboxylic	179	12327						İ			
29	U.VCIODENIANECATNOVVIIC .											

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, *C	Boiling point °C	<i>p</i> - Toluidide	Anılıde	p-Nitro- benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	β-Bromobutyric acid (β-Bromobutanoic acid)	20	12216					92 3		bp 183 4	
2	$trans-\beta$ -Ethyl- $\alpha$ -methylacrylic acid	24	112 <sup>12</sup> cis 94 <sup>10</sup>				91, cis 46	80			ngo 1 4578 cis ngo 1 4485
3	d l-α- <b>Azidobutyric acid</b> (d l-α- Triazobutyric acid)	24	8102					38 9, bz - pet eth		bp 64 <sup>7</sup> , D <sub>20</sub> <sup>20</sup> 1 038	
4	Undecylenic acid (10-Undecen- 1-oic acid 10-Hendecen-1-oic acid)	24 5	275					87		1 030	Cu salt, 232-4, Pb salt, 80
5	·	24 5 5 5	300d					132			
6	d l-α-Bromopropionic acid	25 7	203 5	125	99, 100			123	bp 145- 50	bp 159~ 60d	
7	n-Undecylic acid (n-Undecanoic acid, n-Hendecanoic acid)	28 5, α 13 4, β 16 3	280, 284	80	71		68 2	103			
8	α-Chloroisobutyric acid (α- Chloroisobutanoic acid)	31	11850		69 70, al				bp 133 5	bp 148 9	
9	α-Azidoisobutyric acid (α- Azidoisobutanoic acid α- Triazoisobutyric acid)	31	7502					93-4		bp 71 <sup>16</sup> , D <sub>20</sub> <sup>20</sup> 1 0344	D <sub>33</sub> 1 1433
10	Cyclohexanecarboxylic acid (Hexahydrobenzoic acid)	31,30 1	233		146 (cor)			185 6			
11	α-Ketobutyric acid (2 Oxobutanoic acid)	31	7825		,			117			n <sub>D</sub> <sup>20</sup> 1 3975, p- Nitrophenyl- hydrazone, 194
12 13	Fluoroacetic acid Capric acid (n-Decanoic	31-2 31 5	167-9 268 70	78	70		67, al ,	108 108, 100 1,	hp 224	hn 243-5	n <sup>40</sup> 1 42855
14	acid) Bromochloroacetic acid	31 5	215				66	98, 99 126, 117		bp 174d	Phenyl ester,
15	2-Hexenoic acid	32	sl d		110						46 5, bp 266
	n-Butylmethylglycolic acid	33	,			ł		58			
17	cis-13-Docosenoic acid (Erucic acid)	33-4	26415	75-8	55		62 5, 61 0	84			D 0 860 <sup>55</sup>
18	Levulinic acid ( $\gamma$ -Ketovaleric acid, $\beta$ -Acetylpropionic acid)	33-5 deliq	245-6	108 9, w	102, w	61	84	107-8d			Oxime, 96
19	Pivalic acid (Trimethylacetic acid)	35 5	163-4	119-20	132-3, 128 (cor)		75 6	155 7, 153-4, et ac -pet eth			
20	d,l-α-Methylhydrocinnamic acid (α-Benzylpropionic acid)	36 5	272	130, d 115-6				107 8, d 113-4			
21	1-Cyclohexenylcarboxylic acid	38	1073					128			
- 1	n-Hexylmethylglycolic acid 5-Acetyl-n-valeric acid (δ-	40 40 2, 31-2	250 2280					59			Semicarbazone,
	Acetylpentanoic acid)	40 2, 31-2	162-545					103, w	bр 200		144-6, ac a Nitrile, b p
24	d, l-α-Campholytic acid (1,5,5-Trimethylcyclopenten- 4-carboxylic acid)	<b>₩</b>	162-343, 1 240- 3					103, W	ор 200		200-5
25	β-Chloropropionic acid	41, w , 39, lgr	204						bp 155- 7, D° 1 198	b p 162, D <sub>4</sub> <sup>20</sup> 1 1086, n <sub>D</sub> <sup>20</sup>	Nitrile, b p 175–6, D <sup>18 5</sup> 1 1443
26	d,l-α-Ethylphenylacetic acid (d,l-α-Phenylbutanoic acid)	42	270					85-7, 83		1 42537	

<sup>\*</sup> Derivative data given in order in p , crystal color, solvent from which crystallized

				· · · · · · · · · · · · · · · · · · ·							<del></del>
No	Name	Melting point, °C	Boiling point °C	p Toluidide	Anilide	p Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
27	α-Ethylpimelic acid	43	22317		145						
28	, ,	43,416	312,	88	80		75 0	100	1	1	
29	acid)  Lauric acid (n-Dodecanoic acid)	44.42	17710 299	87	78	ĺ	76	100, 99			
30	, , ,	44	230d	124	116			133, bz	bp 174	bp 186	
31	Elaidic acid (trans-Oleic acid)	44 5, 51	23415		Ì		65	93-4, 89		1	p-Phenylphenacyl
						ļ		90			ester, 73 5, p- Chlorophenacyl
			ĺ		ĺ	ĺ					ester, 56
32	``	45		ļ	J		]	69 70,		bp 245	
	Cyanobutyric acid)							sealed tube			
33	Dimethylneopentylacetic acid	45	230732		}			71			
34	trans-2-Methyl-2-butenoic acid	45 6	185		126, bz			127-8			Isobutyl ester,
	(Angelic acid)		(cor)			<u> </u>		l		}	b p 177 2- Naphthylamide,
											135, bz , Heat-
			Ì					1		ĺ	ing 2 hours in sealed tube →
											tiglic acid, 64-5
35	Dibromoacetic acid	48	232-5					156			
36	α-Bromoisobutyric acid (α- Bromoisobutanoic acid)	48 9	198 200	92 5, al	83, al - w	,		148			o-Toluidide, 63
37	tert-Butylpropiolic acid	48-9	11010		"				bр 66 <sup>13</sup> ,	bp 7515,	
									D <sup>0</sup>	D <sub>0</sub>	
38	Hydrocinnamic acid (β-Phenyl-	48 7, 40	279-80	135	98, 96	36 3	104	105, 82	0 9209	0 9209	p-Phenylphenacyl
	propionic acid)		(cor)		,,,,			, , , , ,			ester, 95
39	β-Cyanopropionic acid	48-50						97, sealed tube	bр 215, п <sup>20</sup>	b p 220 <sup>754</sup>	
								tube	1 42427,	D <sup>20</sup>	
			,						D <sup>20</sup>	1 0353	
40	Benzylpyruvic acid	49 50 (+1/2						180	1 0792		Semicarbazone,
	Donzy i pyranie uesa	H <sub>2</sub> O), w					}	100			175d, Oxime,
				Ï							65, Phenylhy-
41	Bromoacetic acid	50	208		131	88		91	bp 144d	bp	drazone, 144-5
-						,				168-9	
42	2-Pentynoic acid (Ethylpropiolic acid)	50	10010					146			
43	γ-Phenylbutyric acid	52	290					84			
44	n-Pentadecylic acid (n-Penta-	52 3	21216		78	39 5-	77 2	102 5			
	decanoic acid)		1			40 (cor)					
45	β-Campholenic acid	53 5	245			(*** /		86		222 5	Nitrile, 225, D <sup>20</sup>
16	Myristic acid (Tetradecanoic	53 9	20216	93	84		81	103			0 9093
40	acid)	33 9	202	93	04		01	103			
47	Trichloroacetic acid	57 8	197 5	113	97, 94	80		141	bp 1538	bр 168	Phenylhydrazide,
48	α-Acetoxypropionic acid	57 60,	167-					ļ			123 Nitrile, b p
~	(O-Acetyllactic acid)	39-40	70 <sup>78</sup>	l							172-3
49	β-Acetylglutaric acid	58						mono	89		1
								141-2, al -eth			
50	sec-n-Amylmalonic acid (2-	58, bz			dt 219-				ĺ	dı b p	
]	Ethylbutane-1,1-dicarboxylic acid, sec-n-Pentylmalonic	,		Ì	20				ļ	243 5	
	acid, sec-n-Pentylmalonic acid)								:		
			1								<del></del>

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	<i>p-</i> Toluidide	Anilide	p Nitro- benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
51	trans-Brassidic acid	59 7	25610		78		94 2	94		<u> </u>	-
52	5-Phenylpentanoic acid	60			90	1		109			
53	β-Cyclohexylacrylic acid	60	15411	1	ļ			159			
54	β-Chloroisocrotonic acid	61	195 (subl )		108		1	110	bp 142	bp 161	
55	Margaric acid (n-Hepta-decanoic acid)	61 2	23116			48 5 9 0 (cor)	82 6	108, 106			
56	Chloroacetic acid	α 61 3, β 56 2 γ 52 5	189	162	136 7		104	121	bp 130	b p 145 6	
57	$oldsymbol{eta}$ -Bromopropionic acid	62 5						111	b p 80 <sup>27</sup> , D <sup>17</sup> 1 4897	b p 70 <sup>12</sup> , D <sup>15</sup> 1 2609	2-Naphthyl- amide, 174
58	Palmitic acid (Hexadecanoic acid)	62 7	22216	98	90 6, al	42 5	86, 82	106 7, 105 3, al			
59	cis-2-Methyl-2-butenoic acid (Tiglic acid)	64 5 5 0	198 5 (cor)	70015	77, pet eth	64	68	75 6, bz			
60	Cyanoacetic acid	66	(601 )		198-9			119-20	bp 200	bp 207	Nitrile, 29-30, bp 218 9
61	Benzoylformic acid	66		A CONTRACTOR OF THE CONTRACTOR				91			Nitrile, 32-3, b p 206-8, 2,4- Dinitrophenyl- hydrazone, 196- 7d (cor), Phenylhydra- zone, 64
62	Acetoxyacetic acid	66-8, bz	14512		89-90, w					b p 179, D <sup>17</sup> 1 0993	
63	2,3-Dibromopropionic acid	67, stab , 51, unst	16020					130			
64	3,3-Dimethylacrylic acid	67	10620	İ				108			
65	2-Furylacetic acid	67		ļ	85		1	ļ		Ì	
66	3,3,4,4-Tetramethylpentanoic acid	67	,					138			
67	4-Ketocyclohexanecarboxylic acid (4-Oxocyclohexane- carboxylic acid)	67-8, bz - pet eth							bp 140 <sup>20</sup>	bp 15840	Semicarbazone, 200d, Oxime, 147, eth
68	<i>d</i> ./-2-Phenyllactic acid	68 (+½ H <sub>2</sub> O), w 94 (anh ), d 116-7, w, l 115 6, bz						101 2, di- chloro- ethylene, I 62 5 3 5, bz			d,l-Et eth, 60-2, lgr, d- Quinine salt, 216d, al, l-1- Menthyl ester, 55 5-6 0
69	d-Chaulmoogric acid (d-ω- Cyclopentyltridecanoic acid)	68 5	247-820	100	89			106, al	22	b p 230 <sup>20</sup> , D <sup>15</sup> 0 9064	$[\alpha]_D$ +62 in chl
70	Stearic acid (Octadecanoic acid)	70-1, 69 6		102	95 5, al		92	109, 108 4, al			
71	trans-Crotonic acid (trans-2-Butenoic acid)	72, w	(cor)	132, bz	118, w, 115	67 4	95 6	159-60, bz	bp 121	b p 138, D <sub>4</sub> <sup>20</sup> 0 9175, n <sub>2</sub> <sup>20</sup> 1 42524	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, *C	<i>p</i> - Toluidide	Anilide	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	Amıde	Methyl ester	Ethyl ester	Miscellaneous
72	γ-Bromocrotonic acid	74, lgr						101	bp 87 <sup>15</sup> , D <sup>19</sup> 1 490 n <sup>19</sup> 1 498	bp 97- 8 <sup>15</sup> , D <sup>16</sup> 1 402, n <sup>16</sup> 1 490	
73	Caproylacetic acid	74d						100	bp 118¹º, D₄ 09916	bp 127 <sup>19</sup> , D <sup>o</sup> 0 9721	Nitrile, bp 127~ 814, D15 0 9914
74	3-Ketocyclohexanecarboxylic acid (3-Oxocyclohexanecarboxylic acid)	75 6, bz	195-720	,	)					bp 138 <sup>18</sup>	Semicarbazone, 183-4, al , Oxime, 170d , w , Phenylhydra- zone, 125, yel
	2-Thienylacetic acid sec-Butylmalonic acid (Iso- pentane-1,1-dicarboxylic	76 76						148 di 242	<i>di</i> bp 217 8 <sup>748</sup>	<i>d</i> <sub>1</sub> b p 245-50 <sup>762</sup>	,
77	acid) Phenylacetic acid	76 5, subl	256 5 (cor)	135-6	117-8	65	89	156			
78	Eicosanoic acid (Arachidic acid)	77,75	2041	96	92		89	108 9			
79	Glycolic acid (Hydroxyacetic acid)	78 9,80		143, w	97, w	106 8	138	120, al - et ac			On prolonged heating at 100° → anh, 128 30
80	(2-Hydroxyisobutanoic acid	79	212	132-3, w	136, w	80 5	98, acet				,
81	Dimethylglycolic acid) α-Methylcinnamic acid	81, 74		İ				128	ļ		
	2-Ketocyclohexanecarboxylic acid (2-Oxocyclohexane- carboxylic acid)	81-2, eth						120		b p 107- 8 <sup>12</sup> , 159-60 <sup>100</sup>	Alcoholic sol + FeCl <sub>3</sub> → blue color
83	•	81-2			101 2			111	54	50	
84	·	82, 85	•	}	ļ	]	)	101 142	]		ļ
85	α-Benzoylpropionic acid	82-3, bz - pet eth			137-8, al			145-6			Phenylhydrazone, 100 4, br , bz
	Iodoacetic acid	83		l				95			
87	•	83	117 813				91	130-2, w		bp 191-3 <sup>750</sup>	Nitrile, b p 73 <sup>15</sup> , D <sup>o</sup> 1 1495 p-Chlorophenacyl
	acid)			<u> </u>			) 1				ester, 100
89 90		85, 91 85-7	22318		200			148-9		bp 168-	Nitrile, b p
91	Benzoylbutanoic acid) $d, l-\alpha$ -Bromophenylacetic acid	86, 84						148, 144		7119	134-5 <sup>3</sup> Nitrile, 29, b p 242d
92	(4-Methoxyphenyl) acetic acid	87, 84	ł	}	ł	}	ŀ	189	}		2420
93		88	ļ		1	1	}	140	}		
94	Dibenzylacetic acid	89		175, abs al	155, abs al			128-9, bz			
	(2-Tolyl)acetic acid	90, 88	1	ł	1	1	l	161	{	į	1
	$\alpha$ -Thienylglyoxylic acid $\Delta^5$ -Campholytic acid (4,5,5-Trimethylcyclopentene-1-carboxylic acid)	91 91						88 90, Igr			
98	Citraconic acid (Methylmaleic acid)	92d , 92~3, 91d ,	1	mono 170~1,	mono 153,	dı 70 6		<i>d</i> i 185– 7d	dt bp 210-1	<i>dı</i> b p 231	
,	acid)	eth -lgr		yel, eth	155, di 1755, al	/00		/4	210-1	231	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Meiting point, °C	Boiling point, °C	<i>p</i> - Toluidide	Anslide	p-Nitro- benzyi ester	p-Bromo- phenacyl ester		Methyl ester	Ethyl ester	Miscellaneous
99	2-Bromobenzoylformic acid	93-101						136-7, w			Nitrile, 62-4, yel,
100	eta-Chlorocrotonic acid	94	206-11 sl d		123-4			100 1	b p 64 7 <sup>14</sup> , D <sub>4</sub> <sup>22</sup> 1 555, n <sub>D</sub> <sup>20</sup> 1 463	b p 180, 184, D‡° 1 1062, n²° 1 459	Oxime, 162-4d 1-Naphthyl- amide, 169-70
101	Phenyl-n-propylglycolic acid	94						132			
	(2-Chlorophenyl) acetic acid	95, w		170	138 5			175, w			Nitrile, 25, b p 251, o-Tolui- dide, 174
103 104	(4-Tolyl) acetic acid o-Chlorohydrocinnamic acid	95, 91 96 5, w	15915					185 119, bz	bp 255		Nitrile, b p 267-8
	2-Hydroxy-3-phenylpropionic acid	97, 96		!				112			
106	1,2,3,4-Tetrahydro-2-naphthoic acid	97						139	1	1	
	Glutaric acid (1,3-Propane- dicarboxylic acid)	98	302 4	dı 218	dı 223 4	dı 69	dı 136 8	dı 175-6			
- 1	3-Phenoxypropionic acid	98						119		126	
109 110	α-Crotonic acid Phenoxyacetic acid	99 98-9, 99	212 285d		99, al		148 5	112 101 5	161	176	Nitrile, bp 136
	2-Benzofurylacetic acid	100 99			,,		,,	164			
	1-Naphthylglycolic acid	99 124-5	ļ			}		135	ļ	Į	
113	Citric acid	100 (+1 H <sub>2</sub> O), 153 (anh)		<i>tri</i> 189, al	tri 192	<i>tri</i> 102	tri 148	<i>tri</i> 210- 5d, w			
114	2-Methoxybenzoic acid (o- Anisic acid Salicylic acid methyl ether)	100 1	200				113	129			
115	I-Malic acid (Hydroxysuccinic acid)	100–1		dı 206-7	dı 197	mono 87 2, di 124 5	di 179	di 156-7, d,l 162 3			
116	Oxalic acid	101 (+2 H <sub>2</sub> O) (rapid htng), 189 5 (anh) subl at 150-60		mono 169, di 268	mono 148 9, di 254, 246, bz	di 204		mono 219, di 419d			
117	Acetylpyruvic acid (2,4-Diketo- n-valeric acid, 2,4-Dioxo- pentanoic acid)	101, bz						131-2d , al	63–4		
118	n-Butylmalonic acid (Pentane- 1,1-dicarboxylic acid)	101			dı 193			dı 200		di b p 235-40	Mononitrile, 122 5-6 5, w , subl
119	α-Cyanohydrocinnamic acid (Benzylcyanoacetic acid)	101-2						130		b р 176-85 <sup>21</sup>	
120	2-Chloro-6-methylbenzoic acid	102, w			!			167			Nitrile, 82-3, pet
121	Aleuritic acid (9,10,16-Tri- hydroxypalmitic acid)	102, w							63-4		eth Hydrazide, 139- 40, Azide, 50d, al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	<i>p</i> - Toluidide	Anılıde	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
122	(2-Bromophenyl) acetic acid	103 4, 109						186 7			Nitrile, bp 145
123	Benzylacetic acid	103 4d			107 8			113			714 Nitrile, 80 1, 1- Menthyl ester,
124	Pimelic acid	104-5, subl	22315	di 206,	mono 108 9 di 155 6, me al -		di 136 6	dı 175			41
125	2-Toluic acid (2-Methylbenzoic acid)	104 5, 107 8	259751	144	125	90 7	57	142 8 (cor)			
126	Allylmalonic acid	105, eth				46, al		(601)		<i>di</i> b p 222-3	Mononitrile, b p 223, Dinitrile, b p 217 8
127	(4-Chlorophenyl) acetic acid	105-6, 104		190	164 5, al	1		175, ał		32, b p 260	o-Toluidide, 190, bz Nitrile, 30, b p 265-7
128	Δ <sup>2</sup> -Cyclogeranic acid (1,5,5-Tri- methylcyclohexene-6-car- boxylic acid)	106, lgr	13811					120 1, bz - pet eth		b p 101 210	
129		106, <i>d l</i> 109	255		91			80, d l 90	bp 208	bp 220	Nitrile, 73, An- hydride, 56, <i>d l</i> 66
130	Atropic acid (1-Phenylacrylic acid)	106-7, w			134			121 2, w		bp 124 <sup>16</sup> , n <sup>16</sup> 1 52605	
131 132	•	106-7 106 5	250 > 360 sl d, 237 <sup>15</sup>	di 201 2	mono 107-8, dil al, di	di 438	dı 130 6	78-9 mono 93-5, di 175	bp 211	bp 228	Anhydride, 57 8
133 134	Methylneopentylglycolic acid trans-4-Methylcyclohexane-carboxylic acid	109 111			186 7			116 226			
135	•	111			138 9, al -w			134, bz	b p 153 4 <sup>28</sup>	b p 157 8 <sup>10</sup> , D <sub>4</sub> <sup>25</sup> 1 1569 n <sub>D</sub> <sup>25</sup>	
136 137	Ethylmalonic acid 3-Toluic acid (3-Methylbenzoic acid)	111 3, 110-1	263, subl	118	150 126	75 86 6	108	di 214 94,97	:	1 5525	
138	O-BenzoyHactic acid (Lactic acid benzoate)	112				:		124		bp 288	Nitrile, b p 269- 70, 1-Naphth- ylamide, 155, 2- Naphthylamide, 177
	2-Phenylbenzoic acid (1-Naphthyl)glyoxylic acid	113 113 113 113d	į	dı 217,				156 177 151 di 181, al	<i>dı</i> bp	<i>dı</i> bp	Dinitrile, 65-6
143	(4-Bromophenyl) acetic acid 2-Acetylbenzoic acid (Aceto- phenone-o-carboxylic acid)	114, subl 114–5		ac a				192 4 116 5, w	215-25	233–5d 30	Nitrile, 46 7 Oxime, 159, 2,4- Dinitrophenyl- hydrazone, 186

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	<i>p</i> - Toluidide	Anılıde	p-Nitro benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
145	Pyrotartaric acid (Methylsuceinic acid)	115		164	mono 159, et ac 123, chl di 200			di 225			
146	2-Phenoxypropionic acid	115-6, 112-3		115	117			132 3, 130			
147	3-Benzoylpropionic acid	116			150, 145			145~6, w		18 9	Semicarbazone, 181d
148	Benzylmalonic acid	117d , 121			di 217	dı 119 5		dı 225			Dinitrile, 91, 79
	d l-Tropic acid (3 Hydroxy-2 phenylpropionic acid)	117 8 d 130						169		h = 262 A	Niteralo It as 242
j	benzoic acid)	117-8, al			_			133	ł	bp 263 4	Nitrile, bp 243- 4 <sup>734</sup>
151	d l-Mandelic acid (α-Hydroxy- phenylacetic acid)	118, d 133 l 134		172, al	151 2, ai	123 4		133 4 (cor)			
152	l-Arabonic acid	118 9, al		200	204			136, me al			o-Toluidide, 172
153	lpha-Chlorodiphenylacetic acid	118-9d , bz -lgr			88			115		43 4	Anhydride, 219
154	d l-Citramalic acid (d l-2- Hydroxy-2-methylsuccinic acid)	119						mono 140 1	<i>dı</i> bp 112 <sup>15</sup>		Me eth, 90 2 Et eth, 81 3
155	Anilinomalonic acid	119d, al - lgr			mono 157d, w di 162, 246 7, ac a			<i>d</i> i 156	dı 68	<i>dı</i> 45, al	
156	4-Chloromandelic acıd	119 22, 112 3						122 3			Nitrile, 43 Me eth 85-8, bz pet eth
	(3-Nitrophenyl) acetic acid cis-2-Bromoallocinnamic acid	120 120						110 129	b p 11106, D <sub>2</sub> 0	b p 173 4 <sup>36</sup> , D <sub>4</sub> <sup>25</sup>	
159	3-Furoic acid (3 Furancar- boxylic acid)	121	<u> </u> 					169	1 4726	1 3713	
160 161	1-Cyclopentenylcarboxylic acid Cetylmalonic acid (Heptade- cane-1,1-dicarboxylic acid)	121 121 5 2 0, ac a		122	126			mono 130 50d, Igr-al	<i>di</i> 44, eth	di 22	
162	cis-1,3-Cyclopentanedicar- boxylic acid	122 trans 161	}					226			
163	d l-trans-Camphenic acid (d l-trans-Camphene- camphoric acid)	122 3, ac a			di 165, ac a			di 231 2, ac a			
164	Benzoic acid	122.4, at 100, subl	249	158	160, boil 50% al	89	1190	130	bр 1996	bp 2126	
- 1	3,3,3-Trichlorolactic acid	124			164	]	}	96			
	3-Nitrosalicylic acid Diethylmalonic acid	125 (hyd ) 125				dı 91		145 mono 146,			
168	1,14-Tetradecanedicarboxylic acid	126			163			di 224			

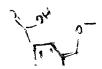
<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, *C	Boiling point, 'C	<i>p</i> - Toluidide	Anılıde	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
169	2,4-Dimethylbenzoic acid	127 (anh )	<b> </b>	<u> </u>	141			179-81		<u> </u>	
170 171	cts-2-Chloroallocinnamic acıd 2-Benzoylbenzoic acid (Benzo- phenone-2-carboxylıc acıd)	90 (hyd) 127 128, 91 (+1 H <sub>2</sub> O), w			195	100 4		112 165 (cor )	52		
172	1,10-Decanedicarboxylic acid	128						185			
173	2-Thenoic acid (2-Thiophene-	129						180			
174	carboxylic acid)  4-Bromopyromucic acid (4- Bromofuran-2-carboxylic acid)	129						155-6		29 b p 235 6	
175		130 (+30% Fumaric a), 137 (pure)		di 142, eth	mono 198, 187, yel, al, di 187, al	di 91 (cor)	168 70, 190	mono 172 3, w 153 sl d, di 260, 181, me al			Heated at 160 → anh , 60, b p 202
176 177	Tribromoacetic acid (1-Naphthyl) acetic acid (1- Naphthaleneacetic acid)	131, 135 131, 135	245d		155, al , 159 6			122 180 I,			
178	trans-α-Bromocinnamic acid	131-2			140			119	23	bp 294-6	
179 180	2,5-Dimethylbenzoιc acid cis-β-Chloroallocinnamic acid	132 132		142	140 134 5			186 76	34	b p 265	
181	trans-Cinnamic acid	133	300	168	153, 109	1168	145 6	147 8			Nitrile, 20-1, bp 255 6
182	Chloromalonic acid	133			<i>dı</i> 118, w			di 170	<i>di</i> b p 206-8 <sup>772</sup>	<i>dı</i> b p 222	Di-p-bromo- anilide 239
183	Sebacic acid (Decanedioic acid, Octane-1,8-dicarboxylic acid)	33, subl	24315	di 201	mono 122 3, di 201 2	di 73 5, 72 6	dı 147	mono 170, di 210, 208			Phenylhydrazide, 194
184	2-Furoic acid (2-Furancar-	133-4, 132	230-2	170 5,	123 5,	133 5	138 5	142 3		34, b p	
185	boxylic acid, Pyromucic acid)  Malonic acid (Propanedioic acid)	134 8- 9		al mono 156d , dı 252-3, al	al mono 132, di 230, 227-8, al	dı 85 5		mono 106 10, di 170, w -al		195 <i>di</i> bp 199	Phenylhydrazide, 194
186	O-Acetylsalicylic acid (Aspırın)	135, rapid htng	140d		136	90 5		138		į	Phenacyl ester, 105
187	β-Campholytic acid (1,5,5-Tri-methylcyclopentene-2-carboxylic acid)	135	247-9, 255-6	114	104, al - w			130	b p 203 4	bp 214	
188	2-Anilinoisovaleric acid	135, w						102 3		bp 275-	
189	Acetone-1,3-dicarboxylic acid	135d , et ac	:		<i>dı</i> 155, al					80	Oxime, 53 4 w Acids or alkalis  → acetone b p
190	d I-cis-Camphenic acid (d I cis- Camphenecamphoric acid)	135–7		į	dı 212			dı 225			56 + CO <sub>2</sub>
191	Phenylpropiolic acid	1367, subl		142	128, 126, 125	83		99-100, 109			Melts under wat

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, *C	<i>p</i> - Toluidide	Anılıde	p-Nitro- benzyl ester	p-Bromo- pheпасуі ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
192	trans-Glutaconic acid	136–8			mono 167, di 228						Acetic anhy- dride → anh
193 194	3-Ethoxybenzoic acıd Methylmalonic acid	137 137, 138d		mono 145d , dı	220			139 0- 5 217, 206			
195	trans-α-Chlorocinnamic acid	137-8		228, 214 116, al	118, al			121 2	33	b p 209 <sup>75</sup> , D <sub>4</sub> <sup>25</sup> 1 1719, n <sub>2</sub> <sup>25</sup>	
196	3-Thenoic acid (3-Thiophene-	138					130	180		1 5705	
197	carboxylic acid)  cis-Cyclobutane-1,2-dicar-	138						di 228, w	di bp	di b p 238-42 <sup>720</sup>	Anhydride, 75
198	boxylic acid  2-Pyridinecarboxylic acid (Picolinic acid)	138						107	225	238-42.20	/1-3
199	(3-Chloromethyl) benzoic acid	138, w						124		b p 168 9 <sup>25</sup>	Nitrile 67 al bp 258 60
200	5-Chloro-2-nitrobenzoic acid	139, w			164, eth			154, eth	48 5, me al		Methylamide, 134, al -w , Di- methylamide, 104 5
201	Anhydrocamphoronic acid	139			202 3				α 138, β 45		1013
202	Butane-1,1,4-tricarboxylic acid	139 40, bz -et ac			<b>топо</b> 177					tri b p 175 6 <sup>18</sup> , D <sup>15</sup> 1 0726	
203	meso-Tartaric acid	140			mono 193-4, pa yel, w	93		dt 187, 189 90, dil me al			Diphenylhydra- zide 245
	3-Nitrobenzoic acid 3-Bromo-4-toluic acid (2-Bromo-4-methylbenzoic acid)	140 140		162	154	141	132	143 137, subl	78 5, 70	47, 40-1	Nitrile, 47
206 207	2-Chloro-4-nitrobenzoic acid (2-Nitrophenyl) acetic acid	140-2 141, 138			168			172, al 161	73-5		
208	Furanacrylic acid (β-(2-Furyl)- acrylic acid)	141	286					168 9	)		
209	2-Anilinobutyric acid	141			92, al			123, w		26, b p 278	Nitrile, 39
210	(2-Naphthyl) acetic acid (2- Naphthaleneacetic acid)	141-2, 143						200, 205			
	4-Chioro-2-nitrobenzoic acid	142, w		122 5	128			172, al 118	41 3 29	bp 293	Nitrile, 98
	trans-β-Chlorocinnamic acid 2-Chlorobenzoic acid	142 142, 140		122-5 131	114, 118, pet	106	106	142, 202	bp 234	bp 243	
214	(2-Bromophenoxy) acetic acid	142 5, al			eth			151, al		bp 160 70 <sup>16</sup>	

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized



No	Name	Melting point, °C	Boiling point °C	<i>p</i> - Toluidide	Anılıde	p-Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
215	Suberic acid (Octanedioic acid, Hexane-1,6-dicarboxylic acid)	144, 139 41		di 218, 219	mono 128 9, di 186-7	di 85	dı 1442	mono 125 7, di 216-7		<i>dı</i> bp 282 6	
216	Asaronic acid (2,4,5-Tri- methoxybenzoic acid)	144, bz - pet eth	ca 300	,	154 5			184 5	97 5, yel	72, yel	Nitrile, 112-4, al
217	(2-Chlorophenoxy) acetic acid	145 6, w			121			149 5	bр 186-8	32	
218	2-Nitrobenzoic acid	146			155	112	107	176	bp 275, 269, D <sup>20</sup> 1 286	30, b p 148 5010	
219	Phthalonic acid	146	<u> </u>		mono 176 di 208			α 179d β 155d	. 200		Phenylhydrazone, 171 2
220	(2-Hydroxyphenyl) acetic acid	147 149, 141			200			118			
221	2-Anilinovaleric acid (2- Anilinopentanoic acid) Diphenylacetic acid	147-8, al -w 148		172 3	180			99, etb - pet eth 167 5 8 0			Nitrile, 51, pet eth
223	Diglycolic acıd	148, 142		<i>mono</i> 148, w	mono 118, di 152, eth al (2 1)			mono 135			
224 225	Oxanilic acid (4-Hydroxyphenyl)acetic acid	148 9 148 50, 148, w			di 154			228 175			Benzoate of amide,
226 227	2-Bromobenzoic acid Benzilic acid (α-Hydroxy- diphenylacetic acid)	150 150		189-90	141 174 5	110 99 5	102 152	155 153, chl, 154-5	bp 243 4 74-5	bp 254-5 34	Acetate, 98, ac a
228	Citric acid (2-Hydroxypropane- 1,2,3-tricarboxylic acid)	153 (slow htng )		<i>tri</i> 189 al	tri 192, al-w	tri 102	tri 148	<i>tri</i> 210 5d			Triphenyl ester, 124
229 230 231	2,5-Dichlorobenzoic acid	153 153 153			198		207	198 155 233			
232	=	(cor)	21615	241	mono 151 3 w di 240 1 al	106	154 5, 152 6	mono 125 30, w , di 220	3, b p 162 <sup>10</sup>	d <sub>1</sub> 8, bp 112 <sup>10</sup> , fp 0	Diphenyl ester, 105-6, al -w
	(4-Bromophenoxy) acetic acid	153-4 al			ai					5 <b>4</b> , al	Phenyl ester, 73, al
	3-Bromobenzoic acid	154 155			136	105	120	155	31 2	bp 254-5	Oxime, 159
í	2,4,6-Trimethylbenzoic acid 2-Chloro-4-methylbenzoic acid	155, 153 155-6						188 182			Nitrile, 61-2,
238	(4-Chlorophenoxy) acetic acid	155 6, w ,			125		136	133	bр 177-80	49	subl
	3-(1-Naphthyl)propionic acid Tartronic acid (Hydroxy- malonic acid)	156 156 8d						104 di 198, dil al,	177 00	!	
241	Benzoylpyruvic acid	156 8d (+1 H <sub>2</sub> O), al -w						195-6d   138d	59, 62	46	1-Oxime, 98- 100d (+1 H <sub>2</sub> O)

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point °C	<i>p</i> - Toluidide	Anilide	p-Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
242	Cyclobutane-1,1-dicarboxylic acid	157, w 158			di 214			dı 275 7		b p 218 '2 di b p 222 6	Dihydrazide 109 10 al-w
243	3-Chlorobenzoic acid	158 155			122 5 al	107	116	134	21 bp 231	b p 245	
244	Salicylic acid (2 Hydroxy- benzoic acid)	158 3, subl at 76		156	136	97 8	140	142 139	-8 6 b p 223 3	1 3 b p 234 231 5	
245	1-Naphthoic acid	161 2 (cor)			162 3 164		135 5	202 205		2313	
246	2-Iodobenzoic acid	162			141	111	143	110	184	Ì	
	2-Anilinopropionic acid	162, w			127, al			144		bp 272	Nitrile, 92, al N-Acetyl, 143, w
248	4-Dibenzothienylacetic acid	162						206			
249	Alloxanic acıd	162 3d,						191, w	171, et ac	115, acet -	Phenylamide 99,
		eth								chl	eth
250	5-Chloro-3-nitrosalicylic acid (5- Chloro-2-hydroxy-3-nitro benzoic acid)	163						199		91, al	
251	2-Benzofurylacetic acid	163						210		1	
252	Cholanic acid	164, ac a						175		93-4, 80% al	$[\alpha]_0^4 + 21.74 \text{ in}$ chl, Propylester 56-7, Butyl ester, 53
253	4-Nitrophthalic acid	165		<i>mono</i> 172	192			200d			
254	Itaconic acid (Methylene- succinic acid)	165			mono 151 5, eth	di 90 6	di 1174	di 191 2 8, al			
255	5-Bromosalicylic acid (5-Bromo-2-hydroxybenzoic acid)	165			222			232	61, b p 264 6	50	
256	6-Chloro-3-nitrobenzoic acid	165, w	.					178, w	73, me al	28 9	Nitrile, 105-6
	3,4-Dimethylbenzoic acid	166, 164			104, 108			130			
258	Tricarballylic acid (Propane-	166			tri 252,		tri	tri 205			
	1,2,3-tricarboxylic acid)				PhNO <sub>2</sub>		138 2	7d			
259	benzoic acid)	166						133			
260	d,l-Phenylsuccinic acid	167-8, 84		mono	mono			mono (α)			
		(anh ), d l 173	Ī	(α)	(α)			158 9			
		4		175, mono	175, mono			mono (β) 145, di			
		7		(β) 168-9	(β) 171,			211			
			,		di 222						
ł	Mesitylacetic acid	168						210			
262	3-Chloro-4-hydroxybenzoic acid	169 70, w , 164-5						180 2	106 7	77 8	Nitrile, 155
263	d-Tartaric acid	169 71			mono 180d, 194 (cor), ac a,	di 163	di 204	<i>mono</i> 171-2, <i>di</i> 196d, al			Phenylhydrazide, 240
					<i>dı</i> 263 4d., al						

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point *C	Boiling point °C	<i>p-</i> Toluidide	Anilide	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
264	Azobenzene-3-carboxylic acid	170 1,						198-9,	58, me al		
265	2,2-Diphenylpropionic acıd	or, al 171-175						or, al 149			
266	8-Chloro-1-naphthoic acid	171 2,						207 5, red,		50	
247	45 25 11 11 11	al-w				1		al			Niverte 103 4
267	4-Bromo-2,5-dimethylbenzoic	171 5 2 5, fgr		ļ		ļ		209-10			Nitrile, 103-4
268	5-Chlorosalicylic acid (5- Chloro-2-hydroxybenzoic acid)	172 w						226-7	50, b p 249d	25	Nitrile, 165-7, Phenyl ester, 81-3, Me eth, 81-2, Et ester, 118
269	4-Chloro-2-methylbenzoic acid	172					1	183		bp 258	Nitrile, 67
270	2,4-Dibromobenzoic acid	174				1	}	198			
271	3-Aldehydeobenzoic acid (3 Formylbenzoic acid)	175						190d	53	bp 278	Nitrile, 79-81, eth, Semicar- bazone, 265, Phenylhydra- zone, 164
	3-Thianaphthenecarboxylic acid	175		ĺ	173	Ì		198			
273	Apiolic acid (2,5-Dimethoxy 3,4-methylenedioxybenzoic acid)	175, w				;	ļ		71-2, w		Nitrile, 135 5, al -w
274	Allomucic acid (2,3 4,5-Tetra- hydroxyadipic acid)	176d , w						175 6, w , di 209d ,		di 139-41 al	Polyphenylhydra- zide, 218d, al
275	8-Bromo-1-naphthoic acid	178, bz			151, al			w 179–80	33, pet eth	52, pet eth	
	3-Phenanthrylacetic acid	178		Ì		ĺ		176			
277 278	Acetylenedicarboxylic acid 4-Toluic acid (4-Methylbenzoic	179 179 80,	275	160, 165	144 5.	104 5	153	di 294d 160, 158			
	acid)	subl 182		,	148, 140			,	:		
279		180			166, al	}		197-8	82	66	Nitrile, 117, subl
280	5-Bromo-2,4-dimethylbenzoic acid	180 1		}				197 5-8 5			Nitrile, 88-9
281	,	181 (anh )			154			164			
282	methoxybenzoic acid)  N-Benzovlanthranilic acid  (2. Benzamidobenzoic acid)	181			279			218-9	100	98	Nitrile, 156
283	4-Chloro-3-nitrobenzoic acid	181-2			131			156, al	83, me al	59, yel	Nitrile, 100-1
284	3,5-Dinitrosalicylic acid (3,5-	182 (anh ) 174	•					181			
	Dinitro-2-hydroxybenzoic acid)	(+1H <sub>2</sub> O)		Ì		ĺ					
	4-Fluorobenzoic acid	182 182 6		}				154, 154 5			Nitrile, 35
286	4-Chloropicolinic acid (4- Chloropyridine-2-carboxylic acid)	182d	,					158, 152-4	57-8		Phenyl ester, 68, pet eth
	2,4-Dinitrobenzoic acıd	183				142	158	203			
288	2-Naphthoic acid	184, 185 5		192, al	171, bz,			192-3, al,			
289	Bromo-2-hydroxybenzoic	184			173			195 165			Nitrile, 49-50
290	acid)  2-Anilinoisobutyric acid (2- Anilinoisobutanoic acid)	184 5, w			155, al			136			Nitrile, 93-4, al
291	4-Anisic acid (4-Methoxy- benzoic acid)	184 6, 184 2	275-80	186	169-71	132	152	167, 162~ 3, w			
		(cor)		}	}	1					

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC A€IDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

Νo	Name	Melting point *C	Boiling point, °C	<i>p-</i> Toluidide	Anılıde	p-Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
292	(2-Carboxyphenyl)acetic acid (Homophthalic acid)	185, 180		****				228			
293	Acetylanthranilic acid	185, ac a			167 8, al			177, al			Nitrile, 133, w , N-Methylamide 172 al
294	Succinic acid (Butanedioic acid, Ethane-1,2-dicarboxylic acid)	185, 182 8	235d	mono 179 80, di 254 5- 5 5,	mono 148 5, di 230, al	dı 88	dı 2110	mono 157 di 260d, w			
295	5-Bromopyromucic acid (5- Bromofuran-2-carboxylic acid)	186, w		260				144 5		bp 234	Hydrazide 135 5 6 0, Azide, 66 7
296	1 '	187			208	136	151	183			712.00,00
297	3-Iodobenzoic acid	187				121	128	186			-
	5-Bromo-2-toluic acid (4- Bromo-2-methylbenzoic acid)	187, subl						180			Nitrile, 70
	2-Cyanobenzoic acid (Phthalic acid mononitrile)	187, 192						173	151	70	
	3-Nitroanisic acid (4-Methoxy- 3-nitrobenzoic acid)	187			163						
301 302	Fluorene-2-acetic acid Coumarin-3-carboxylic acid	187 187d, w			250			266 236	116-7	94	Nitrile, 182
	d-Camphoric acid (1,2,2- Trimethylcyclopentane-1,3- dicarboxylic acid)	187 5-8 0, 1 187, d,1 202, 208		(α) 212-4, (β) 190-6	mono (α) 204, 209 10, mono	65 5		mono (α- amıde-β- acıd) 176, mono (β-	(α) 77 (β) 86 di b p 263 4	(α) 47 8 (β) 57 di b p 285 6	1.00
					(β) 196, di 226, di, 1 226			amide-α- acid) 182-3, di 192-3		1100	
	3-Bromophthalic acid	188								127 8	Anhydride, 132-4
305	4-Bromo-3,5-dinitrobenzoic acid	188, al			i			188, pa yel, al- w	125 me al-w	118, ai -w	
306	Butane-1,2,3,4-tetracarboxylic acid (low melting form)	189, w			187 (rapid htng ), al -w			di 181d, dil $H_2SO_4$ tetra 310d, w	<i>tetra</i> 75–6, w	<i>dı</i> 168 w	Heating → monoanh of high melting form
- 1	Anthroxanic acid α-Chrysenic acid (ο-2- Naphthylbenzoιc acid)	190, 196d 190				:		211-2, w 169 70	70 63	64-5	
309	I-Ascorbic acid	190d , <i>d.l</i> 168-9									[α] <sup>23</sup> +48 in me al, Diphenylhydrazone, 178d, red, Di-p nitrophenylhydrazone 262d al Di 2 4 dinitro phenylhydrazone, 282d,

<sup>\*</sup>Derivative data given in order m p., crystal color, solvent from which crystallized

# TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point *C	<i>p</i> - Toluidide	Anilide	p-Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
310	Chlorofumaric acid	191 2,			186, al	dı			dı b p	dı b p	Ethyl ester amide,
311	N-Methylacetylanthranilic acıd	ac a 192 3				138 5	155		224	250 sl d	N-Methylamide, 171 2 N-Ethylamide, amide, 140
312	Coumarilic acid (Coumarone- 2-carboxylic acid)	192 3, w	310 5 sl d		159			159		27	Nitrile, 36, Phenyl ester, 101
313 314	Dimethylmalonic acid trans-Aconitic acid	193, subl 194 5d (cor), cis 125 → trans on heat-			di 189, cis, mono 170d, al	83 6	<i>tri</i> 186	di 269 tri 250 → br , 260 → sinters			Heat → Itaconic acid, 165
315	Benzylidenemalonic acid	ing 195 6d						dı 189 90	dı 44	85, di 32	Mononitrile, 183
316	4-Ethoxybenzoic acid	198 195 6			169, 170 172			202			Dinitrile, 87
317	trans-3-Nitrocinnamic acid	199 <i>cis</i> 138			1,2	174	178, 173	196			
318	Chrysodiphenic acid (2-Phenyl- naphthalene-1,2'-dicarboxylic acid)	199						1-mono 275, 2'-mono 220	1-mono 171 5, me al , 2'-mono 124, di 90		
319	3,4-Dihydroxybenzoic acid	199-200d			166	188		212	134 5 w		
320	(Protocatechuic acid) 3-Hydroxybenzoic acid	200, subl		163 dıl al	156 7, w 155	106 8	176, 176 1-	170 167 w			
321	Phthalic acid (Benzene-1,2-dicarboxylic acid)	200 6, 191 (sealed tube), 230 (rapid htng)		mono 150 (slow htng), 160 5 (rapid htng), di 201	mono 170 di 253-5	di 155 5	dı 152 8	mono 149, di 220			
322	3,4-Dichlorobenzoic acıd	201 2,		ai 201		 		133			
323	§4-Chloromethyl)benzoic acid	208 9 203						173			Nitrile, 79 80,
324	5-Bromo-2-nitro-4-toluic acid (2-Bromo-4-methyl-5 nitro-	203, 200						191		61	al, bp 263 Nitrile, 132
325	benzoic acid) 4-Bromo-3-nitrobenzoic acid	203 4			156, or -			156	104	74	Nitrile, 120
326	d,l-Tartaric acid	203-4 (+1 H <sub>2</sub> O) 205 6			yei , al di 235-6	dı 147 6		dı 226, w -me al			
327	cis-Apocamphoric acid	(anh ) 204, w , trans			mono 212				!		Anhydride, 178, al
328	3,5-Dinitrobenzoic acid	190-1, w 204-5			234	157	159	183			

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p , crystal color, solvent from which crystallized

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	<i>p</i> - Toluidide	Anılıde	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
329	Mesaconic acid (Methylfumaric acid)	204 5 (cor), subl		mono (α) 196, di 212, al	mono (α) 202, mono (β) 163, di 185 7	di 134 (cor)		mono (α) 222, mono (β) 174, di 176 5			
330	5-Bromo-3-nitro-4-toluic acid (6-Bromo-4-methyl-2-nitro- benzoic acid)	206						171			Nitrile, 130, subl
331	Anthracene-9-carboxylic acid	207, pa				3			111, yel		Nitrile, 170-2,
332	(meso-Anthroic acid) Vanillic acid	yel , al 207, 210				140d				44, b p 293	lgr
333	trans-2-Coumaric acid (trans-2 Hydroxycinnamic acid)	207 8d, subl, w				152 5		209d			Acetate, 154 5, 146, bz
334 335 336	Oxamic acid Pentamethylbenzoic acid 4-Coumaric acid (4-Hydroxy- cinnamic acid)	210 210 210 3, 206 (anh )			148-9			419d 206 194	137 126		Acetate, 200 5
337	trans-2-Chlorocinnamic acid	212, yel,			176			168	10 5, b p	bp 16212	Nitrile, 40
338	<b>2,4-Dihydroxybenzoic acid</b> (β-Resorcylic acid)	al 213d (ra- pid htng ), 216d , 217			126-7	188 9		222	278-9		Loses H <sub>2</sub> O of crystallization at 100 Easy loss of CO, gives m p varying
339	2-Bromo-3,5-dinitrobenzoic acid	213						216, pa yel,	109, me al -w	74, al	from 194 to 236
340 341	4-Dibenzofurylacetic acid Mucic acid	214 214d (varies with htng rate)	-			310	225	al -w 212 mono 192d, di 220			
342)	3-Chloroanisic acid (3-Chloro- 4-methoxybenzoic acid)	223 255 214 5						193	94 5		
343	4-Hydroxybenzoic acid	215, 213- 4 210		203-4, al	196 7, yel, w	180 2	191 5 (cor), 184	162 (+1 H <sub>2</sub> O), w			
344 345	Piperic acid 3-Chloro-2-naphthoic acid	216 216 7, me al -w				145		237	58, me al	50	
347	3-Nitrophthalic acid Acenaphthene-5-carboxylic acid 4-Cyanobenzoic acid (Terephthalic acid mono- nitrile)	218 219, bz 219, 214		dı 226	di 234 179	189 189		di 201d 198 223	62	54	Nitrile, 110-1
	4-Phenylbenzoic acid 3-Hvdroxv-2-naphthoic acid	221 222 3 (cor)		221-3	243-4, ac a, 249 (cor)			223 217 8 (cor), yel, al			

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point *C	p Toluidide	Anilide	p Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
351	4-Hydroxy-2-naphthoic acid	225 6		206				217 8			
352	5-Bromo-3-nitro-2-toluic acid (4-Bromo-2-methyl 6 nitro-	226		,				235			Nitrile, 106-7, subl
353	benzoic acid) 9-Fluorenecarboxylic acid	227 230, 225						251			
354	Biphenyl-2,2'-dicarboxylic acid (2.2 Diphenic acid)	227 233 229	<b>.</b>		mono 176, di 229- 30, al	di 187, 182 6		mono 193, 190 1, di 212, w			
355	Methyliminodiacetic acid	227d	İ		50, 4.			mono 169, di 169			
356	2,4,6-Trinitrobenzoic acid	228						264d			
357	Piperonylic acıd	229, 228						169, ai			
358	5-Nitrosalicylic acid	229 30	1		224	ĺ		225		1	ĺ
359	4-Chloro-3-hydroxy-2-naphthoic acid	231, yel						225	116, yel		
360	1-Phenanthroic acid	232	!			l	1	284			1
361	3-Pyridylacrylic acid	233						148			
362	4-Bromo-3-hydroxy-2-naphthoic	233-5d ,			161-2		•				Acetate, 183
ĺ	acid	yei, ai-	i	ĺ		ĺ	ľ			ľ	
		ac a									1
363	4-Chloro-1-hydroxy-2-naphthoic acid	234, al		143–4	180–1				120-1	92-3	o-Toluidide, 148 9, m-Toluidide, 188-9
364	3-Chloro-2-nitrobenzoic acid	235 w			186					İ	
365	Benzophenone-2,4-dicarboxylic acid	235, w						di >288	di 107		
366	5-Bromo-2-hydroxy-3-toluic acid (5 Bromo-2-hydroxy 3- methylbenzoic acid)	236		ļ	125, al -w			75-8	109	75	
367	2-Thianaphthenecarboxylic acid	236				i '		177		i	
368	Butane-1,2,3,4-tetracarboxylic	236~7			di 168,			di 169d	tetra	1	D1-1mide, 320d,
	acid (high melting form)	(slow htng )			acet (slow htng)				63-4, lgr		w
369	7-Bromo-1-naphthoic acid	237 (cor ), 60% al			202, al -w			247, 50% al	55 (cor ), 60% me al	46	
370	3-Pyridinecarboxylic acid	237 8 235, 232		150	85, 132, bz - lgr ,			128, 122	ai		
371	trans-2-Nitrocinnamic acid	240, cis 146-7			265, w	132	141	185			
372	2-Chloroquinoline-3-carboxylic acid	240						200-1			
373	4-Nitrobenzoic acid	241		204, 192	211, 204	168	137	201, 198	96	57	
374	Azobenzene-4-carboxylic acid	241, red, al		,	,			224-5, red		86-7, or - red, al	Nitrile, 120-1, br, bz, Propyl ester, 64, red,
375	4-Chlorobenzoic acid	243, 240			194, al	129 5,	126	179, 170	44	bp 238	lgr
376	7-Chloro-1-naphthoic acid	243,			185, al -	al		237,	54,		
377	3-Chlorocinchonic acid (2-Chloroquinoline-4- carboxylic acid)	60% al 244, al			w 202, al			50% al 334-5, al - w , 276-8 (after	60% al 89~90, acet	64 5	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, *C	Boiling point *C	<i>p</i> - Toluidide	Anılıde	p-Nitro benzyl ester	p-Bromo- phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
378	5-Chloro-1-naphthoic acid	245, 241-2 subl						239		42	Nitrile, 145
379	Azobenzene-2,2'-dicarboxylic acid	245, dk yel, al						mono 215d, red-br, et ac, di 294d, red-br,	di 101, red, me al	dı 85, pa red, al	
380	Anthracene-1-carboxylic acid (α-Anthroic acid)	245, yel, al, 252						ac a 260, al	108, ac a		Nitrile, 126, yel, Phenyl ester, 207-9, yel
381	2-Amino-9,10-anthraquinone-1- carboxylic acid	250 2, or - red						300, or , PhNO <sub>2</sub>			
382	4-Bromobenzoic acid	251-3			197	180		189-90, w			p-Phenylphenacyl ester, 193
383 384	9-Phenanthroic acid 4-Bromocinnamic acid	251, 253 251 3			183			233	80		
385		253 4 (+1 or 2H <sub>2</sub> O)						181	24	13, b p 17315	Nitrile, 102
386	Gallic acid (3,4,5-Trihydroxy- benzoic acid)	253–4d , 222–40d			207	141	134	189			
387 388	1-Acenaphthoic acid 2-Phenanthroic acid	256 260						228 243			
389	Cinchomeronic acid (Pyridine- 3,4-dicarboxylic acid)	260d , w			dı 199- 206			3-mono 200d , 4-mono 170d , w , di	3-mono 182 4-mono 154-72, di 141	4-mono 131-3, bz, di b p 172 <sup>21</sup>	Imide, 229–30, subl
390 391	5-Bromo-1-naphthoic acid Chelidonic acid (\gamma-Pyrone-2,6-dicarboxylic acid)	261, 256 262						163~5d 241 245	di 122 5	48-9 227, di 63	Nitrile, 147, subl p-Phenylphenacyl ester, 195-8d
	4-lodobenzoic acid 5-Chloro-2-naphthoic acid	270, 265 270, al			210 202 5	141	146	217 186–7	81	45	Nitrile, 144
	3-Phenanthroic acid Quinoline-3-carboxylic acid	270 272						234 198			,
396		272, pa yel, al			248 9, pa yel, bz- ac a			317, yel	161 5, yel, acet, 155	142, yel , al	Benzyl ester, 135- 6, yel, al
397	Anthracene-2-carboxylic acid (β-Anthroic acid)	281, yel, al						293-5, yel, al		134-5	
1	trans-4-Nitrocinnamic acid	285					191	204, 217			
399	Fumaric acid ( <i>trans</i> -Butanedioic acid)	286-7, (sealed tube), >200, subl, 293-5			mono 233 0- 4 5, di 313 4, ac a	150 8		270, 300 2 subl , <i>di</i> 266d	di 102, bp 192	mono 66, di b p 218	At 230 → maleic anh 56
400	Muconic acid	289d (slow htng), 306 (rapid htng)			-			di 240d			trans-trans 296– 8, cis-cis 195

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

# TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	p Toluidide	Anılıde	p-Nitro benzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
401	9,10-Anthraquinone-2- carboxylic acid	290-2, yel, ac a			258 60			280, ac a -bz	170	147	
402	9,10-Anthraquinone-1- carboxylic acid	293 4, pa yel, ac a	,		288 9, pa yel, PhNO			280 pa yel, al	189, pa yel, me al	169, yel , ai	Nitrile, 247, yel, ac a
403	Bromoterephthalic acıd (2-Bromobenzene-1,4- dıcarboxylıc acıd)	299			1			dı 270	1-mono 145, 4-mono 164 di 54		
404	Terephthalic acid (Benzene-1,4-dicarboxylic acid)	300, subl without melting			di 334 7, PhNO <sub>2</sub>	dı 263 5	dı 225	dı >225			
405	Chloroterephthalic acid (2- Chlorobenzene-1,4-di- carboxylic acid)	>300, w			•			dt > 300	dı 60		
406	4-Pyridinecarboxylic acid (Isonicotinic acid)	324						156			
<b>40</b> 7	9,10-Anthraquinone-2,3- dicarboxylic acid	240-2, yel, ac a						mono > 340, br, ac a			Anhydride, 290
408	Isophthalic acid (Benzene-1,3- dicarboxylic acid)	348, subl				202 5	179 1	mono 280, di 280			Ba salt (+6 H <sub>2</sub> O) very soluble— differentiates from Tereph- thalic acid
409	Benzophenone-4,4'-dicarboxylic	subl <360						di >300	di 224 231		Dinitrile, 204-5
410	Trimesic acid (Benzene-1,3,5- tricarboxylic acid)	380 (cor )			tri 118~ 20d, ac a		tri 197 (sealed tube)	365d (cor)	tri 143-4, me al	tri 132 3, al 133 after sin- tering at 127	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or via the acyl halide. All of them appear therefore under the same title

Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid

$$RCOCI + H_2O \longrightarrow RCOOH + HCI$$
 $Acid$ 
 $(RCO)_2O + H_2O \xrightarrow{NaOH} 2RCOONa \xrightarrow{H^+} RCOOH$ 

From the acyl halide in water

For directions and examples see Wild, p 180

From the acyl halide with aqueous sodium hydroxide

See Vogel, p 369, Wild, p 180

From the acid anhydride with water

See Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, J Chem Soc, 97, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

See Linstead, pp 16 7 Wild, p 184

Amide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{NH_3}$  RCONH<sub>2</sub> + NH<sub>4</sub>CI  $\xrightarrow{A_{Cld}}$   $\xrightarrow{A_{Cld}}$   $\xrightarrow{A_{Cld}}$  RCOOH + NH<sub>3</sub>  $\longrightarrow$  RCONH<sub>2</sub>  $\xrightarrow{RCONH_2}$   $\xrightarrow{A_{mide}}$ 

Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia

For directions and examples see Cheronis, p. 440, Shriner, p. 200, Vogel, p. 361, Wild, p. 181

From the acid chloride in benzene with aqueous ammonia

See D Swern, J M Stutzman and E T Roe, J Amer Chem Soc, 71, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

See Linstead, p 14, Wild, p 182

From the neat acid with gaseous ammonia

See J A Mitchell and E E Reid, J Amer Chem Soc, 53, 1879 (1931)

From the acid anhydride with aqueous ammonia

See Wild, p 184, 185

Anılıde \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCl  $\xrightarrow{C_6H_5NH_2}$  RCONHC<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NH<sub>3</sub><sup>+</sup>Cl<sup>-</sup>  
RCOOH + C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>  $\longrightarrow$  RCONHC<sub>6</sub>H<sub>5</sub> + H<sub>2</sub>O  
(RCO)<sub>2</sub>O + C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>  $\longrightarrow$  RCONHC<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NH<sub>3</sub><sup>+</sup>RCOO<sup>-</sup>

From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether *For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

See Wild, pp 181, 219

From the acid and aniline at high temperatures

See Vogel, p 362

\*Derivatives recommended for first trial

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

From the acid anhydride with aniline without solvent

See Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

See Linstead, p 15, Wild, p 185

p-Toluidide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{p\text{-CH}_3C_6H_4NH_2}$  RCONHC $_6H_4CH_3$ - $p$  +  $p\text{-CH}_3C_6H_4NH_3$ + $^+Cl^-$   
RCOOH +  $p\text{-CH}_3C_6H_4NH_2$   $\longrightarrow$  RCONHC $_6H_4CH_3$ - $p$  +  $H_2O$   
(RCO) $_2O$  +  $p\text{-CH}_3C_6H_4NH_2$   $\longrightarrow$  RCONHC $_6H_4CH_3$ - $p$  +  $p\text{-CH}_3C_6H_4NH_3$ + $^+RCOO^-$ 

From the acid chloride with p-toluidine in ether or benzene

For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and p-toluidine at high temperatures

See Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, p-toluidine and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

From the acid anhydride with p-toluidine without solvent

See Cheronis, p 459, Linstead, p 17

From the acid anhydride with p-toluidine in benzene

See Wild, p 185

1- and 2-Naphthylamide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{1- \text{ or } 2 \text{ } C_{10}\text{H}_7\text{NH}_2}$  RCONHC<sub>10</sub>H<sub>7</sub> + C<sub>10</sub>H<sub>7</sub>NH<sub>3</sub><sup>+</sup>Cl<sup>-</sup>

Naphthylamide
(1 or 2-)

From the acid chloride with the naphthylamine

For directions and examples see Cheronis, p 446, P W Robertson, J Chem Soc, 115, 1210 (1919)

p-Nitrobenzyl ester \*

RCOONa + 
$$p$$
-NO<sub>2</sub>C<sub>6</sub>H<sub>4</sub>CH<sub>2</sub>X  $\rightarrow$  RCOOCH<sub>2</sub>C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub>- $p$  + NaX (X = Cl, Br, I)

From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol *For directions and examples see* Cheronis, pp. 447, 448, Shriner, p. 200, Vogel, p. 362, Wild, pp. 144. 5 From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

See F F Blicke and F D Smith, J Amer Chem Soc, 51, 1947 (1929)

From the sodium or the potassium salt of the acid and p-nitrobenzyl bromide in 1 2 water-ethanol See E Reid, J Amer Chem Soc, 39, 124 (1917)

From the sodium or the potassium salt of the acid and p-nitrobenzyl chloride or iodide in 1 2 water-ethanol

See J A Lyman and E E Reid, J Amer Chem Soc, 39, 701 (1917)

p-Bromophenacyl ester \*

RCOOH + 
$$p\text{-BrC}_6\text{H}_4\text{ COCHN}_2$$
  $\xrightarrow{\text{CuCl}_2}$  RCOOCH $_2\text{COC}_6\text{H}_4\text{Br-}p$  +  $N_2$ 
 $p$  Bromodiazoaceto-
phenone  $p$ -Bromophenacyl ester

From the sodium salt of the acid and p-bromophenacyl bromide in aqueous ethanol

<sup>\*</sup>Derivatives recommended for first trial

For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with p-bromophenacyl halide in 1 2 water-ethanol

See W L Judefind and E E Reid, J Amer Chem Soc, 41, 1043 (1920)

phenone

From the sodium salt of the acid (neutralization with sodium hydroxide) with p-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, J Amer Chem Soc, 52, 818 (1930), C G Moses and E E Reid, J Amer Chem Soc, 54, 2101 (1930)

From the acid and p-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, J Amer Chem Soc, 73, 5301 (1951)

p-Phenylphenacyl ester \*

From the sodium salt of the acid (neutralization with sodium carbonate) and p-phenylphenacyl bromide in aqueous alcohol

For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, J Amer Chem Soc., 52, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and p-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, J Amer Chem Soc, 54, 2059 (1932)

For dibasic acids from the acid, ethylamine and p-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, J Amer Chem Soc, 54, 2059 (1932)

From the acid and p-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, J Amer Chem Soc , 73, 5301 (1951)

Methyl ester

RCOOH + CH<sub>3</sub>OH 
$$\xrightarrow{\text{H}_2\text{SO}_4}$$
 RCOOCH<sub>3</sub> + H<sub>2</sub>O  
RCOOH + CH<sub>2</sub>N<sub>2</sub>  $\xrightarrow{\text{RCOOCH}_3}$  + N<sub>2</sub>  
Methyl ester

From the acid with methanol and a catalytic amount of sulfuric acid

For directions and examples see Linstead, p. 16, Vogel, p. 383

From the acid and diazomethane in ether

See B Eistert, in Newer Methods of Preparative Organic Chemistry, Interscience, New York, 1948, p 513

Ethyl ester

From the acid and ethanol in the presence of a catalytic amount of sulfuric acid For directions and examples see Vogel, pp 383, 385, 386, 387
From the silver salt of the acid with ethyl iodide
See Vogel, p 388

\*Derivatives recommended for first trial

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

S-Benzylthiuronium salt.\*

RCOONa + 
$$[C_6H_5CH_2SC(NH_2)_2]^+Cl^- \rightarrow [C_6H_5CH_2SC(NH_2)_2]^+RCOO^- + NaCl$$
  
S-Benzylthiuronium chloride S-Benzylthiuronium salt

From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, Bull. Soc. Chim. [5], 5, 1153 (1938), S. Veibel and K. Ottung, Bull. Soc. Chim. 6, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, J. Amer. Chem. Soc., 58, 1004 (1936).

Phenylhydrazide.

RCOOH + 
$$H_2NNHC_6H_5$$
  $\rightarrow$  RCONHNHC<sub>6</sub> $H_5$  +  $H_2O$   
Phenylhydrazide

From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, J. Amer. Chem. Soc., 64, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

<sup>\*</sup>Derivatives recommended for first trial.

# TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES I. Acyl Fluorides (Listed in order of increasing b.p.)\*

No	Name	Boiling point,	Melting point,		Density	A	cid	Amide	Anilide	p-	2- Naphthyl	Miscellaneous
•••	. Tanto	°C,	°C	n <sub>D</sub>	g/ml	Bp,°C	Mp,°C		- Timilae	Toluidide	amide	1713conuncous
1	Acetyl fluoride	20-1			1 00215	118		82	114	147	134	
2	Propionyl fluoride	44 6				141		81	106	126		
3	Fluoroacetyl fluoride	50 5-51				167 9	31-2	108				
4	Trichloroacetyl fluoride	66 8				197	57 8	141	97	113		
5	n-Butyryl fluoride	67				162 5	1	115	96	75	125	
6	Chloroacetyl fluoride	73 5				İ	63	120	137	162	117 8	
7	Phthaloyl difluoride	224 6	42-3				206	220(di)	253 (di)	201 (dı)		
8	Phenylacetyl fluoride	88-917	].				76	156	118	136	159	

Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

,	Name	point,	point					Amide	Anilide	T-16 3.3	Naphthyl	Miscellaneous
,		.с	·c	n <sub>D</sub>	g/ml	Bp,°C	<b>М</b> р,°С			P- Toluidide	amide	
2	Acetyl chloride	51-2		1 389720	1 10520	118		82	114	147	134	
J	Oxalyl chloride	64	-12	1 43413	1 488 13 4	ĺ	101	419d	246	268		,
						j	(dıh-			l		
1						ļ	yd)					
	Fluoroacetyl chloride	72-3				167 9	31-2	108		1		
	Acrylyl chloride	76		1 434320	1 114 20	140		85	105	141		3
	Propionyl chloride	80	1	1 405120	1 06520	141		81	106	126		
	Isobutyryl chloride	92		1 407920	1 01740	154 5	1.5 (	128	105	107		
	Methacrylyl chloride	95-6 98		1 4435		160 5 163	15-6	102-6 72-3	58	[		
	Vinylacetyl chloride n-Butyryl chłoride	101-2		1 412120	1 02820	162 5		115	96	75		
	Pivalyl chloride	105-6		1 4121	1 0204	102 3	35	154	129	120	i	
	Dichloroacetyl chloride	108	1			194	1	98	118	153		:
	Chloroacetyl chloride	108-10		1 45420	1 399718	189	63	120	137	162		
)	DL-α-Chloropropionyl	110-11	İ	1 44020	1 28520	185-6	1	80	92	124		
l	chloride				-							
14	Methoxyacetyl chloride	113		,		204	1	97	58	ĺ		
15	DL-Ethylmethylacetyl	115-6	1 1			176		112	110	93	] .	
	chloride							ļ				
	Isovaleryl chloride	115	1	1 4136243	0 98544 4	176		135	109 10	107	138 5	
17	Acetylglycyl chloride	115-8					206	137	ļ		ĺ	Hydrazide 115
			i i	=000			l	ļ. <u></u> .				Me ester 58 9
	Trichloroacetyl chloride	118		1 47020	1 62040	197	57 8	141	97	113		
19	Cyclopropane carbonyl	120	1		1 152%	186	18	125	1	[		
20	chloride Ethoxyacetyl chloride	123-4				207	1	80 2	ļ			
1	trans-Crotonyl chloride	126		1 46 18	1 0820	207	72	161	118	132		
	n-Pentanoyl chloride (n-	126	1 1	1 42020	1 000420	186	<b> </b> '-	106	63	74	112	
22 /	Valeryl chloride)	120		1 420	1 000-1	100	ł	100	0.5	′¯	112	
23	Allylacetyl chloride	128			1 07416	188 9	<u> </u>	94	Ī	İ	İ	1
1	Bromoacetyl chloride	133-5			1 908°	208	50	91	131		134	
	Cyclobutane carbonyl	137				195	1	153	[			
	chloride	142 3				)	Į	}	)	ļ		
26	6-Methoxypropionyl	138		1 424		10710	ĺ	50 5	ļ			
1	chloride					}			}	ļ		
	Diethylacetyl chloride	140		1 4234		190		107		l		
	β-Chloropropιonyl chloride	144		1 455	1 331 13	ĺ	42		119	121		
29	lsocaproyl chloride (4-	147	] }		0 972540	199	j	121	112	63	}	
į	Methylpentanoyl											
70	chloride)	150		1 42 43 17		}		į	}			
30 6	α-Acetoxypropionyl chloride			1 424117	1 192		57 60,		ļ			
- 1	(O-Acetyl lactoyl chloride)	part d				l	40		1	}	}	
31	DL~α-Bromobutyryl	150-2				217d	-4	112	98	92		
31	chloride	150-2				21/0	- <b>"</b>	814	100	1/2		
32	n-Hexanoyl chloride (n-	153	] ]	1 42620	0 97520	205		100	95	75	107	
	Caproyl chloride)								1			
- 1	. ,,											
34 1	Furoyl chloride	173 4					133~4	142-3	124	107		
35 /	r-Heptanoyl chloride	175		1 434515	0 96340	223	ĺ	96	70 (65)	81	101	
	(Enanthoyl chloride)											
36   1	Hexahydrobenzoyl chloride	183 4		1 476615,	1 09645	ĺ	29 30	185	143 4			
	(Cyclohexane carboxylic		}	1 471120			ļ			]		
<u>.</u> [.	acid chloride)	100	[					1.70				
37 3	3-Fluorobenzoyl chloride	189,				1	124	130				
٫, ا	Succinvi dichlo-ida	204 190d	20	1 47315	1 39515		186	260 (3-)	230 (4)	255 (4.)		
	Succinyl dichloride I-Fluorobenzoyl chloride	190a 193	0	14/3.	1 3734"	l	186 183	260 (di) 154 5	230 (di)	255 (dı)		
37	r reas oneuzo às cusoride	173	ľ l				103	ر بدر:	1			

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

# TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point,	Melting point,	n <sub>D</sub>	Density	Α	cıd	Amide	Anilide	p-	2- Naphthyl	Miscellaneous
		°C	°C	"В	g/ml	Bp,°C	Mp,°C	Amac	Amilde	Toluidide	amide	Miscellaneous
40	n-Octanoyl chloride (n-	196			0 94920	239	16	110, 106	57	70	103	
	Capryloyl chloride)											
41	Benzoyl chloride	197	-1	1 55815	1 21220		122	130	163	158		
42	Diethyl malonyl dichloride	197		1 553720	1 218715		125	224 (di)				
43	2-Fluorobenzoyl chloride	206	4				126 5	116				
44	Phenylacetyl chloride	210		1 53320	1 16854		76	156	118	136	159	
45	n-Nonanoyl chloride	215	( )		0 94645	255	12	99	57	84	103	
	(Pelargonyl chloride)											
46	Glutaryl dichloride	218		1 47320	1 32440	302	97 8	175 6 (di)	224			
47	4-Chlorobenzoyl chloride	222	16	1 57920	1 36240		240	179 170	194			
48	Hydrocinnamoyl chloride	225 d			1 1352		48	105	98, pet	135		
	(β-Phenylpropionyl chloride)								eth			
49	3-Chlorobenzovi chloride	225					158	134	122	1		
50	Phenoxyacetyl chloride	225-6	1 1			1	98-9	101 5	101			
51	4-Methylbenzoyl chloride (4-Toluyl chloride)	225 6	-39	1 54520	1 168640		179-80	160	145	160 165		
52	n-Decanoyl chloride	232				268 70	31	108 98	70	78	104	
53	2-Chlorobenzoyl chloride	233				1	142	142	118	131		
54	3-Methoxybenzoyl chloride	242 4	) j			)	110,	1				Benzylamine sa
							105					of acid, 112
55	3-Bromobenzoyl chloride	243,					155	155	136			Hydrazide, 151
	·	239										
56	2-Bromobenzoyl chloride	245	11			1	150	155 6	141			Hydrazide, 153
57	2-Methoxybenzoyl chloride	254						129	131			Phenyl ester, 59
58	4-Methoxybenzoyl chloride	262 3	22	1 5820	1 26140		184	162 3	169, 163	186		Anisidide, 202
	(Anisoyl chloride)	sl d										
59	Phthaloyl dichloride	276	15 6	1 56920	1 40640		200 6	220 (dı)	253 5	201 (dı)		
		1							(d1)		,	
60	3-Nitrobenzoyl chloride	278	35				140	143	154	162		
61	1-Naphthoyl chloride	297 5	20			1	161	202				Piperidide, 85

 $<sup>^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

#### II. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

		Boiling	Melting		Density		cıd	Ţ		р-	2-	
No	Name	point, °C	point, °C	n <sub>D</sub>	g/ml	Bp °C	Mp,°C	Amide	Anilide	Toluidide	Naphthyl amide	Miscellaneous
1	$\beta$ -Ethoxypropionyl chloride	7852	-		<del>                                     </del>	12017	<del>                                     </del>	51				
2	Azidoacetyl chloride	5020					16	58				
3	Oleyl chloride	163 <sup>2</sup>					16	75 6	41	42 5		
4	γ-Phenoxybutyryl chloride	15520	}	ł	1	l	64-5	80		l	ł	
,	, , , , , , , , , , , , , , , , , , , ,	1			1		60			1		
5	γ-Phenylbutyryl chloride	140-212				290	52	84 5		ŀ		
6	ω-Undecenoyi chioride (ω-	12814	ł	1	Ì	275	24 5	87	l	ļ	}	}
•	Undecylenoyl chloride, ω-	1.20				- 1 - 1	12.0	"				
	Hendecenoyl chloride)											
7	Benzoylformyl chloride	1259	ļ		Į.	1	64-6	91			}	2,4-Dinitrophenyl-
·												hydrazone of acid, 196 7, yel
8	Iodoacetyl chloride	49-5215	1		2 2525	1	83	95	143-4	1	}	
9	$\beta$ -lodopropionyl chloride	81 15		1			82, 85	101,		1	Ì	1
	1		ĺ	1				142	1			
10	Palmitoyl chloride	19417	11-2	1		1	63	106-7	90	98	109	
11	Myristoyl chloride	17416	1-3			1	54, 58	107	84	93	108	
12	Phenylpropiolyl chloride	115-617					136-7	108-9, 99 100	126	142		
13	Dodecanoyl chloride	14518	-17	1 44620		299	44	110 102	78	87	106	
	(Lauroyl chloride)											
14	α-Phenoxybutyryl chloride	128-		)		258	82 3	111 123	93-4	]	ļ	Phenyl ester, 48-9
		3138	1	1			99					
15	Cyanoacetyl chloride	570 5					66	119 20	198-9			
16	Nicotinyl chloride	9015		]		}	235	122	85	]		
17	Dibenzylacetyl chloride	20218					89	129	155			
18	α-Phenoxypropionyt	11520					115 6	132	117	115	117	
	chloride						112 3					
19	DL-α-Bromoisovaleryl chloride	5915					44	133	116	124	145	
20	3-Ethoxybenzoyl chloride	135- 40 <sup>16</sup>	27 8				137	139				
21	α-Bromoisobutyryi chloride	5230		1 47523		l	48 9	148	83	92 5	135	
22	4-Isopropylbenzoyl chloride	12110					256-8	153		-		
23	Benzilic acid chloride (α-	193 527			i		150	154 5	175	190		Me ester 74-5
	Hydroxydiphenylacetyl chloride)									.,,		142 63(6) 74 3
24	1-Naphthoxyacetyl chloride	19410					190	155	144			4-Phenetidide,
25	Hexahydrophenylacetyl	98				244-6	33	171-2				
	chloride (Cyclohexylacetyl	10023			[							
	chloride)	16615			1							
26	Azelayl dichloride	16618			J		106 5	175 (dı)	186-7	191 (dı)		
37	2 Nikanahanana 183 - 23	140"+	20						(d1)			
	2-Nitrobenzoyl chloride Mesaconyl dichloride	1489	20				146	176	155			
28		64-514					240 5	177 (di)	186 (di )	212		
1	(Methylfumaryl di-				1							
20	chloride)	10027										
29	1-Naphthylacetyl chloride	18823					131	180 1 154				
30	2,4,6-Trimethylbenzoyl chloride	155-618		1 526325	1 096745		152	188				
31	3-Formylbenzoyl chloride	13020			}		175	190				Me ester, 53,
/							. , ~					Semicarbazone
′												of acid, 265
32	4-Ethoxybenzoyl chloride	16020					198	202	170			51 acid, 205
	Sebacoyl dichloride	18216		1 4684	1 121220		134 5	210(di)	198 (di)		[	
					4			-10 (at )	. 20 (ai )			

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

II. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\* (Continued)

No	Name	Boiling	Melting	4	Density	A	ad	Amide	Anilide	p-	2- Naphthyl	Miscellaneous
NO	Name	point, *C	point,	a <sub>u</sub>	g/ml	Bp, C	Mp, °C	Aillide	Aimide	Toluidide	amide	Miscenaneous
34	Adipyl dichloride	130-218					153	220 (di)	240-1	241		Di-N-methyl- amide, 152-3
35	Benzylmalonyl dichloride	14115					117d	225 (di)	217 (di)			,
36	Phenylmalonyl dichloride	12215	}			1	152-3	233	1			Di-Me ester, 51
37	trans-Aconityl trichloride	155-720		1	•	1	194-5	260 (tri)				
	(1,2,3-Propylenetricar-	1				ļ	ļ	(sın-				
	boxylic acid trichloride)					İ		ters)	1	1		
38	Fumaryl dichloride	6313	1	1 500418	1 4084	1	300-2	266 (di)	314 (di)			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)\*

Salicy   Salicy   Chioride   Size   Size   Size   Salicy   Chioride   Salicy   Size		No	Boiling	Melting	_	Density	A	cid	Amida	Amilide	p-	2 Naphthyl	Miscellaneous
2 Sternoyl chloride   202-3*   33-40   30-1   388."   345-7   380.00   197   380.00   197   380.00   30-1   30-1	No	Name	point, °C	point, °C	n <sub>D</sub>		Bp, *C	Мр ℃	Amide	Aniide	<i>p</i> - Toluidide	Naphthyl amide	Miscellaneous
3   2-lodolenzoyl chloride   33-0   30-1	1	Salicyloyl chloride	9215	19-20				158	142	136	156	189	
	2	Stearoyl chloride	202-36	23			1	70 1	109	95	102	112	
4	3	2-lodobenzoyl chloride		1				162	184				
5   Albremobenzoyl chloride   245-7   42   1 5701   1 3887   245   276   345-7   280 (dr)   276   27	4	trans-Cinnamovi chloride	258		1 620237	1 163237		122	147 8	151	168		
		-	1		1 0202	1 1032	ĺ			1	100		Hydrazide 164
7 2-Naphthoyl chloride 8 2,4-Diairrobenzoyl chloride 9 4-Formythenzoyl chloride 10 4-Nitrophenzoyl chloride 11 2-Naphthoxyacetyl chloride 12 258 48 256 256 256 258 268 266 277 278 288 266 217 288 203 203 278 288 268 267 288 268 267 288 268 267 288 268 277 288 268 278 288 203 278 203 27		,	1	1	1 57047	1 38847		1		1''			1 .
7   2-Naphthoyl chloride   30-6   43   46   258   24-Diptimipotenzoyl chloride   4-Formythenzoyl chloride   4-Formythenzoyl chloride   4-Formythenzoyl chloride   4-Formythenzoyl chloride   54   153   198   1	_			, ,	. 570				200 (41)				Dihydrazide, 220
4-Nitrophenylacetyl chloride   258   48   256   3   398   198   38   3198   38   3198   38   3198   38   3198	7	2-Naphthoyl chloride	304-6	43				184-5	192				Piperidide, 88-90
A-Nitrophenylacetyl chloride		=		1 1			ł	183	203				Me ester, 70
10   4-Nitrophenylacetyl chloride   48   153   198   198   4-Phennetidde, 164-5, Et est 48-9   12   Diphenylacetyl chloride   56-7   148   168   180   173   191   2	9	4-Formylbenzoyl chloride	258	48			Ì	256					Me ester, 63,
10   4-Nitrophenylacetyl chloride   54   153   198   198   4-Phenetidide, 164-5, Et est 48-9   154   156   147   145			1								·		Phenylhydra-
1   2-Naphthoxyacetyl chloride   54   156   147   145   4-Phenetidde, 164-5, Et est 48-9     12   Diphenylacetyl chloride   56-7   64 5   240   185   240   185     13   Irrans-2-Nitrocinnamoyl chloride   68 9, 74   77   78   241   201   211   204   226 (dr)     15   4-Nitrobenzoyl chloride   150-2**   75   241   201   211   204   226 (dr)     16   3-Nitrophthaloyl dichloride   77   77   77   77   77   77   78   250 (dr)   230-2   251   250 (dr)   234 (dr)   226 (dr)     19   Terephthaloyl dichloride   83-4   270   218   210   218   210     20   4-Ioobenzoyl chloride   83   270   218   210   218   210     21   Diphenylcarbamyl chloride   77-8   265   189   228   212     22   22-Diphenic acid dichloride   77-8   265   189   228   212     23   a_a-Diphenylpropionyl chloride   259   60   242   3   217-8     24   Phenauthrene-2-carboxylic acid chloride   114-5   228   223   226 (218   228   223   226 (218   228   227   230   225   230   225     24   Phenauthrene-2-carboxylic acid chloride   260   260   233   227   216-7     25   Phenauthrene-3-carboxylic acid chloride   260   230   225   230   225   230   226   230   246   230   246     26   Diphenyl-4-carboxylic acid chloride   260   260   233   227   216-7   216   228   227   216-7   216   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   216-7   228   227   228   227   228	10	4 Nitrophonylogotyl oblovido		10				1.52	100	100			zone of acid, 226
12   Diphenylacetyl chloride   13   Irans-2-Nitroennamoyi chloride   68   9,   240   185   234   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 73   Me ester, 74   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 108   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 72   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 72   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 74   Me ester, 63   Me ester, 64   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 63   Me ester, 65			l	+			1	1	1		ļ ,		4. Phenetidide
1	••	2 . Aphthoxy 2000 y chloride						150	177	172			
13   Irans-2-Nitrocinnamoy    64 5   240   185   3,5-Dintrobenzoyl chloride   150-21   75   241   201   211   204   226 (dr)   218   201 (dr)   234 (dr)   226 (dr)   226 (dr)   218   201 (dr)   234 (dr)   226 (dr)   226 (dr)   230-2   251   265   280   265   280													1
A-Nitrobenzoyl chloride   150-21 <sup>3</sup>   74   75   74   76   77   77   77   78   78   78   78								148	1	180	173	191 2	
3.5-Dintrobenzoyl chloride   68 9,   74   204 5   183   234	13	· ·		64 5				240	185				Me ester, 73
15	14		{	(00			[	204.5	102	224	·		Ma asta- 100
15   4-Nitrobenzoyl chloride   150-21s   75   241   201   211   204   226 (d1)	14	5,5-Dinarobenzoyi embride						204 3	163	234			1
16   3-Nitrophthaloyl dichloride   77     218   201 (dr)   224 (dr)   226 (dr)   Di Me ester 4	15	4-Nitrobenzoyl chloride	150-215	l				241	201	211	204		Li color, 75
Benzylidene malonyl dichloride   18   Fluorene-9-carboxylic acid chloride   18   Fluorene-9-carboxylic acid chloride   19   Terephthaloyl dichloride   83-4   230-2   251   230-2		=	1					1	i		•		
Fluorene-9-carboxylic acid chloride   77	17	•		1				l .	, ,		`		Di Me ester 45
Chloride   Terephthaloyl dichloride   83-4			\ 	j .							ľ		
Terephthaloyl dichloride	18			77				230-2	251				Me ester, 63
20   4-lodobenzoyl chloride   83   77-8   265   189   Me ester, 86, E ester, 72, Igr	19			83-4					> 250 (di)	334-7			Di-l-naphthyl-
Diphenylcarbamyl chloride (Diphenylaminoformyl chloride)   22 2,2'-Diphenic acid dichloride   94   228 9 212   23 α,α-Diphenylpropionyl chloride   95-6   173-4 149   Benzyl ester, 72 lgr chloride   259 60 242 3 217-8   252 232 226 218   252 232 226 218   252 232 226 218   252 233 227 216-7   264 (4-Phenylbenzoyl chloride)   269 Phenanthrene-3-carboxylic acid chloride   27 Phenanthrene-3-carboxylic acid chloride   28 trans-4-Nitrocinnamoyl chloride   28 trans-4-Nitrocinnamoyl chloride   29 Fluorenone-4-carboxylic acid chloride   29 Fluorenone-4-carboxylic acid chloride   29 Fluorenone-4-carboxylic acid chloride   27 Phenanthrene-3-carboxylic acid chloride   28 trans-4-Nitrocinnamoyl chloride   29 Fluorenone-4-carboxylic acid chloride   27 Phenanthrene-3-carboxylic acid chloride   28 trans-4-Nitrocinnamoyl chloride   28 trans-4-Nitrocinnamoyl chloride   29 Fluorenone-4-carboxylic acid chloride   27 Phenanthrene-3-carboxylic acid chloride   28 trans-1-Nitrocinnamoyl chloride   28 trans-1-Nitrocinnamoyl chloride   28 trans-1-Nitrocinnamoyl chloride   29 Fluorenone-4-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   28 trans-6-Nitrocinnamoyl chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride   29 Fluorenone-1-carboxylic acid chloride			1							ì			,
Diphenylcarbamyl chloride (Diphenylaminoformyl chloride)   22 2,2/2-Diphenic acid dichloride   94   228 9 212   23 27-Diphenic acid dichloride   95-6   173-4 149   Benzyl ester, 71   24   Phenanthrene-2-carboxylic acid chloride   102   259 60 242 3 217-8   259 60 242 3 217-8   259 232 226 218   259 232 226 218   259 233 227 216-7   269 233 227 216-7   269 233 227 216-7   27   Phenanthrene-3-carboxylic acid chloride   114-5   269 230, 225   269 230, 225   270   27   27   27   28   28	20	4-lodobenzoyl chloride						l '	218	210			
(Diphenylaminoformyl chloride)   22 2,2'-Diphenic acid dichloride   94   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   228 9 212   239 212   248   259 60 242 3 217-8   259 60 242 247-8   259 60 242 247-8   259 60 242 247-8   259 60 242 247-8   259 60 242 2		51.1						265					
22   2,2'-Diphenic acid dichloride   94   228 9   212   23   24   24   25   25   25   25   25   25	21			86					1189		,		
22   2,2'-Diphenic acid dichloride   94   228 9 212   23 α,α-Diphenylpropionyl chloride   95-6   173-4 149   149   259 60 242 3 217-8   259 60 242 3 217-8   259 60 242 3 217-8   259 60 242 3 218   259 60 242 248   259 60 242 248   259 60 242 248   259 60 242 248   259 60 242 248   259 60 242 248   259 60 242 248													ester, 72, igr
ride 23 α,α-Diphenylpropionyl chloride 24 Phenanthrene-2-carboxylic acid chloride 25 Phenanthrene-9-carboxylic acid chloride 26 Diphenyl-4-carbonyl chloride 27 Phenanthrene-3-carboxylic acid chloride 28 Irans-4-Nitrocinnamoyl chloride 29 Fluorenone-4-carboxylic acid chloride 29 Fluorenone-4-carboxylic acid chloride 30 Fluorenone-1-carboxylic acid chloride 40 Plenylbenzoyl chloride 51 Phenanthrene-3-carboxylic acid chloride 52 Irans-4-Nitrocinnamoyl chloride 53 Pluorenone-4-carboxylic acid chloride 54 Pluorenone-4-carboxylic acid chloride 55 Pluorenone-1-carboxylic acid chloride 56 Pluorenone-1-carboxylic acid chloride 57 Pluorenone-1-carboxylic acid chloride 58 Pluorenone-1-carboxylic acid chloride 59 Pluorenone-1-carboxylic acid chloride 50 Pluorenone-1-carboxyli	22			94				228 9	212				
Chloride   Phenanthrene-2-carboxylic acid chloride   Phenanthrene-9-carboxylic acid chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carboxylic acid chloride   Diphenyl-4-carboxylic aci		-											
24   Phenanthrene-2-carboxylic acid chloride   101   259 60   242 3   217-8     217-8     259 60   242 3   217-8     259 60   242 3   217-8     259 60   242 3   217-8     259 60   242 3   217-8     259 60   242 3   218     259 60   242 3   218     259 60   242 3   218     259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   259 60   242 3   218   218   228   223   218   228   223   218   228   223   216   248	23			95-6				173-4	149				Benzylester, 71 2
acid chloride   Phenanthrene-9-carboxylic   acid chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carboxylic   chlo								250.50	242.2	217.			
25	24	•		101				259 60	242 3	217-8			
acid chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carbonyl chloride   Diphenyl-4-carbonylic chloride   Diphenyl-4-carbonylic acid chloride   Diphenyl-4-carbo	25			102				252	232 226	218			
26   Diphenyl-4-carbonyl chloride   114-5     228   223		•											
Chloride   Phenanthrene-3-carboxylic acid chloride   116-7   269   233 227   216-7   286   217   286   217   286   217   286   217   286   217   27, yel   230, 225   230, 230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230, 230   230, 230   230, 2	26			114-5				228	223				Me ester, 117-8,
27   Phenanthrene-3-carboxylic acid chloride   116-7   269   233 227   216-7   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286   286   217   286													Et ester, 46
acid chloride	,,			116 7				260	222 227	216 7			
28	21	· ·		110-/				209	233 221	Z10-/			
chloride  29 Fluorenone-4-carboxylic acid chloride  128, yel  227, yel 230, 225  Oxime of acid, 263, Me ester, 103  Oxime of acid, 263, Me ester, 103  Oxime of acid, 263, Me ester, 103  Oxime of acid, 263, Me ester, 103  Oxime of acid, 263, Me ester, 103  Oxime of acid, 269, Et ester, 103  Oxime	28			124		•		286	217				Me ester, 161
acid chloride  yel  263, Me ester 132, Et ester, 103  Oxime of acid 230 Me ester 230 Me ester 86 9, Et ester 86		chloride											·
30 Fluorenone-1-carboxylic acid chloride 140, yel 229-30 229-30 230 Me ester 86 9, Et ester	29	•						227, yel	230, 225				Oxime of acid,
30 Fluorenone-1-carboxylic acid chloride 140, yel 229-30 229-30 229-30 230 Me ester 86 9, Et ester		acid chloride		yel									263, Me ester,
30 Fluorenone-1-carboxylic acid chloride 140, yel 229-30 Oxime of acid 230 Me ester 86 9, Et ester	J												1
acid chloride yel 230 Me ester 86 9, Et ester	30	Fluorenone-1-carboxylic		140					229-30				i
86 9, Et ester	50	•		i	ļ								230 Me ester,
	ļ	*****		,									86 9, Et ester,
					ĺ								

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Boiling	Melting	_	Density	A	cią	Amide	Anihde	p-	2- Naphthyl	Miscellaneous
NO	Name	point, °C	point, °C	n <sub>D</sub>	g/mi	Bp, *C	Mp,*C		Aminoc	Toluidide	amide	Miscolaticous
31	Azobenzene-4,4'-dicar- boxylic acid dichloride		144-5, red				330d					Di-Me ester, 242, Di-Et ester, 146
32	9, 10-Anthraquinone-2-car- boxylic acid chloride		147			}	290, yel	280	258-60			Me ester, 170
33	Di-(1-naphthyl) acetyl chloride		167-9				228 5					
34	9, 10-Anthraquinone-2,6-dı- carboxylic acid dıchloride		197-8				>400	> 370				
35	9,10-Anthraquinone-1,4-di- carboxylic acid dichloride		203-5				>300					
36	9,10-Anthraquinone-1,5-di- carboxylic acid dichloride		260-3				>390					Di-Me ester, 236, Di-Et ester, 155, yel

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES III. Acyl Bromides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point	Melting		Density	A	cıd	Amide	Anılıde	P	2- Naphthyl	Miscellaneous
МО	Name	*C	*C	n <sub>D</sub>	g/ml	Bp, C	Mp °C	Amide	Ailinge	Toluidide	amide	Miscellaneous
i	Oxalyl dibromide	64					101 (hyd )	419d (dı)	254 (dr)	268 (d1)		
2	Acetyl bromide	81		1 453816	1 662516	118		82	114	147	132	
3	Propionyl bromide	103				141	İ	81	106	126		
4	Chloroacetyl bromide	127				1	63	120	137	162	117-8	
5	n-Butyryl bromide	128			Ì	162 5		115	96	75	125	
6	IsovaleryI bromide	138-40				176		135		107	138 5	
7	Trichloroacetyl bromide	143			1 90 15	197	57–8	162 5	95-7	113		4-Nitroanilide, 146-7
8	Bromoacetyl bromide	150			2 425	208	50	91	131		134	
9	DL-α-Bromopropionyl bromide	154-5			2 06146	204	25 7	123	99,110			
10	α-Bromoisobutyryl bromide	162-4				198~ 200	48 9	148	83	92 5	135	
11	DL-α-Bromobutyryl bromide	172 4				12725	-4	112, 108				
12	n-Hexanoyl bromide (n- Caproyl bromide)	175-6				205		100	95	75	107	
13	DL-α-Bromoisovaleryl bromide	184-94					44	133	116	124	145	
14	Benzoyl bromide	218-9			1 57013		122	130	163	158		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

#### III. Acyl Bromides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

No	Name	Boiling	Melting point,	_	Density		cıd	Amide	Anilide	p-	2 Naphthyl	Miscellaneous
NO	Name	point, *C	*C	n <sub>D</sub>	g/ml	Bp, °C	Mp, °C	Amige	Annue	Toluidide	amide	Miscenaneous
1	3-Methylbenzoyl bromide	13752					111	94 97	126	118		
2	n-Pentanoyl bromide (n- Valeryl bromide)	6466				186 5		106	63	74		
3	3-Chlorobenzoyl bromide	14540					158, 155	134	122			
4	2-Chlorobenzoyl bromide	14437					140	142	114, 118	131		
5	2-Methylbenzoyl bromide	13537	1				104 5	143	125	144		
6	2-Bromobenzoyl bromide	16718	1 1				150	155	141	1	1	
7	Phenylacetyl bromide	150-550	l i				76	156	117-8	135-6	159	
8	4-Methylbenzoyl bromide	14712					179-80	160	145 148	160, 165		
9	4-Methoxybenzoyl bromide	18527				İ	184–6	167, 163	169-71	186		
10	4-Chlorobenzoyl bromide	14227	}		1		240	179, 170	194			
11	4-BromobenzovI bromide	13618					251	189	197			
12	Succinyl dibromide	105-613					186	260 (d1)	230 (di)	255 (di)		

<sup>\*</sup>Derivative data given in order  $\, m \, p$  , crystal color, solvent from which crystallized

### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES III. Acyl Bromides b) Solids (Listed in order of increasing m.p.)\*

	N	Boiling	Melting		Density	A	cıd	Amuda	Anılıde	p-	2-	Miscellaneous
No	Name	point, °C	point, °C	n <sub>D</sub>	g/ml	Bp, °C	Mp,°C	Amide	Aninge	Toluidide	Naphthyl amide	Miscellaneous
1	3-Nitrobenzoyl bromide		43				140	143	154	162		
2	trans-Cinnamoyl bromide		48				133	148	151, 153	168		
3	4-Iodobenzoyl bromide		55				270,	217	210			
						1	265			İ		
4	3,5-Dinitrobenzoyl bromide		60			i	204-5	183	234			
5	4-Nitrobenzoyl bromide	Į	64				241	201, 198	211	203		
6	Phthaloyl dibromide		80				206	220 (di)	253 (di)	201 (dı)		

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES IV. Acyl Iodides. Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, *C	n <sub>D</sub>	Density g/ml		cıd Mp, °C	Amide	Anilide	<i>p</i> - Toluidide	2- Naphthyl amide	Miscellaneous
	Acetyl iodide Propionyl iodide n-Butyryl iodide	108 127 146-8			1 9817	118 141 162 5		82 81 115	114 106 103 96	147 126 75	134	,

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

#### IV. Acyl Iodides. Liquids

### 2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

No	Name	Boiling point,	Melting point.		Density	A	Acid	Amide	Andide	p-	2- Naphthyl	Miscellaneous
NO	Name	*C	*C	n <sub>D</sub>	g/ml	Bp, C	Mp, C		Amme	Toluidide	amide	Miscendicous
1	Dichloroacetyl iodide	5515		1 5754		194		98	118	153		
2	Chloroacetyl iodide	374		1 5903	ļ		63	120	137, 134	162	117-8	
3	Benzoyl iodide	10910					122	130	163	158		
4	Trichloroacetyl iodide	7430		1 5711		197	57-8	141	97 94	113		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or via the acyl halide. All of them appear therefore under the same title

Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid

$$RCOCI + H_2O \longrightarrow RCOOH + HCI$$
 $Acid$ 
 $(RCO)_2O + H_2O \xrightarrow{NaOH} 2RCOONa \xrightarrow{H^+} RCOOH$ 

From the acyl halide in water

For directions and examples see Wild, p 180

From the acyl halide with aqueous sodium hydroxide

See Vogel, p 369, Wild, p 180

From the acid anhydride with water

See Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, J Chem Soc, 97, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

See Linstead, pp 16 7 Wild, p 184

Amide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{NH_3}$  RCONH<sub>2</sub> + NH<sub>4</sub>CI  $\xrightarrow{A_{Cld}}$   $\xrightarrow{A_{Cld}}$   $\xrightarrow{A_{Cld}}$  RCOOH + NH<sub>3</sub>  $\longrightarrow$  RCONH<sub>2</sub>  $\xrightarrow{RCONH_2}$   $\xrightarrow{A_{mide}}$ 

Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia

For directions and examples see Cheronis, p. 440, Shriner, p. 200, Vogel, p. 361, Wild, p. 181

From the acid chloride in benzene with aqueous ammonia

See D Swern, J M Stutzman and E T Roe, J Amer Chem Soc, 71, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

See Linstead, p 14, Wild, p 182

From the neat acid with gaseous ammonia

See J A Mitchell and E E Reid, J Amer Chem Soc, 53, 1879 (1931)

From the acid anhydride with aqueous ammonia

See Wild, p 184, 185

Anılıde \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCl  $\xrightarrow{C_6H_5NH_2}$  RCONHC<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NH<sub>3</sub><sup>+</sup>Cl<sup>-</sup>  
RCOOH + C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>  $\longrightarrow$  RCONHC<sub>6</sub>H<sub>5</sub> + H<sub>2</sub>O  
(RCO)<sub>2</sub>O + C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>  $\longrightarrow$  RCONHC<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NH<sub>3</sub><sup>+</sup>RCOO<sup>-</sup>

From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether *For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

See Wild, pp 181, 219

From the acid and aniline at high temperatures

See Vogel, p 362

#### \*Derivatives recommended for first trial

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

From the acid anhydride with aniline without solvent

See Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

See Linstead, p 15, Wild, p 185

p-Toluidide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{p\text{-CH}_3C_6H_4NH_2}$  RCONHC $_6H_4CH_3$ - $p$  +  $p\text{-CH}_3C_6H_4NH_3$ + $^+Cl^-$   
RCOOH +  $p\text{-CH}_3C_6H_4NH_2$   $\longrightarrow$  RCONHC $_6H_4CH_3$ - $p$  +  $H_2O$   
(RCO) $_2O$  +  $p\text{-CH}_3C_6H_4NH_2$   $\longrightarrow$  RCONHC $_6H_4CH_3$ - $p$  +  $p\text{-CH}_3C_6H_4NH_3$ + $^+RCOO^-$ 

From the acid chloride with p-toluidine in ether or benzene

For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and p-toluidine at high temperatures

See Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, p-toluidine and concentrated hydrochloric acid

See Shriner, p 201, Wild, p 154

From the acid anhydride with p-toluidine without solvent

See Cheronis, p 459, Linstead, p 17

From the acid anhydride with p-toluidine in benzene

See Wild, p 185

1- and 2-Naphthylamide \*

RCOOH 
$$\xrightarrow{SOCl_2}$$
 RCOCI  $\xrightarrow{1- \text{ or } 2 \text{ } C_{10}\text{H}_7\text{NH}_2}$  RCONHC<sub>10</sub>H<sub>7</sub> + C<sub>10</sub>H<sub>7</sub>NH<sub>3</sub><sup>+</sup>Cl<sup>-</sup>

Naphthylamide
(1 or 2-)

From the acid chloride with the naphthylamine

For directions and examples see Cheronis, p 446, P W Robertson, J Chem Soc, 115, 1210 (1919)

p-Nitrobenzyl ester \*

RCOONa + 
$$p$$
-NO<sub>2</sub>C<sub>6</sub>H<sub>4</sub>CH<sub>2</sub>X  $\rightarrow$  RCOOCH<sub>2</sub>C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub>- $p$  + NaX (X = Cl, Br, I)

From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol *For directions and examples see* Cheronis, pp. 447, 448, Shriner, p. 200, Vogel, p. 362, Wild, pp. 144. 5 From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

See F F Blicke and F D Smith, J Amer Chem Soc, 51, 1947 (1929)

From the sodium or the potassium salt of the acid and p-nitrobenzyl bromide in 1 2 water-ethanol See E Reid, J Amer Chem Soc, 39, 124 (1917)

From the sodium or the potassium salt of the acid and p-nitrobenzyl chloride or iodide in 1 2 water-ethanol

See J A Lyman and E E Reid, J Amer Chem Soc, 39, 701 (1917)

p-Bromophenacyl ester \*

RCOOH + 
$$p\text{-BrC}_6\text{H}_4\text{ COCHN}_2$$
  $\xrightarrow{\text{CuCl}_2}$  RCOOCH $_2\text{COC}_6\text{H}_4\text{Br-}p$  +  $N_2$ 
 $p$  Bromodiazoaceto-
phenone  $p$ -Bromophenacyl ester

From the sodium salt of the acid and p-bromophenacyl bromide in aqueous ethanol

<sup>\*</sup>Derivatives recommended for first trial

For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with p-bromophenacyl halide in 1 2 water-ethanol

See W L Judefind and E E Reid, J Amer Chem Soc, 41, 1043 (1920)

phenone

From the sodium salt of the acid (neutralization with sodium hydroxide) with p-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, J Amer Chem Soc, 52, 818 (1930), C G Moses and E E Reid, J Amer Chem Soc, 54, 2101 (1930)

From the acid and p-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, J Amer Chem Soc, 73, 5301 (1951)

p-Phenylphenacyl ester \*

From the sodium salt of the acid (neutralization with sodium carbonate) and p-phenylphenacyl bromide in aqueous alcohol

For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, J Amer Chem Soc., 52, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and p-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, J Amer Chem Soc, 54, 2059 (1932)

For dibasic acids from the acid, ethylamine and p-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, J Amer Chem Soc, 54, 2059 (1932)

From the acid and p-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, J Amer Chem Soc , 73, 5301 (1951)

Methyl ester

RCOOH + CH<sub>3</sub>OH 
$$\xrightarrow{\text{H}_2\text{SO}_4}$$
 RCOOCH<sub>3</sub> + H<sub>2</sub>O  
RCOOH + CH<sub>2</sub>N<sub>2</sub>  $\xrightarrow{\text{RCOOCH}_3}$  + N<sub>2</sub>  
Methyl ester

From the acid with methanol and a catalytic amount of sulfuric acid

For directions and examples see Linstead, p. 16, Vogel, p. 383

From the acid and diazomethane in ether

See B Eistert, in Newer Methods of Preparative Organic Chemistry, Interscience, New York, 1948, p 513

Ethyl ester

From the acid and ethanol in the presence of a catalytic amount of sulfuric acid For directions and examples see Vogel, pp 383, 385, 386, 387
From the silver salt of the acid with ethyl iodide
See Vogel, p 388

<sup>\*</sup>Derivatives recommended for first trial

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

S-Benzylthiuronium salt.\*

RCOONa + 
$$[C_6H_5CH_2SC(NH_2)_2]^+Cl^- \rightarrow [C_6H_5CH_2SC(NH_2)_2]^+RCOO^- + NaCl$$
  
S-Benzylthiuronium chloride S-Benzylthiuronium salt

From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, Bull. Soc. Chim. [5], 5, 1153 (1938), S. Veibel and K. Ottung, Bull. Soc. Chim. 6, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, J. Amer. Chem. Soc., 58, 1004 (1936).

Phenylhydrazide.

RCOOH + 
$$H_2NNHC_6H_5$$
  $\rightarrow$  RCONHNHC<sub>6</sub> $H_5$  +  $H_2O$   
Phenylhydrazide

From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, J. Amer. Chem. Soc., 64, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

<sup>\*</sup>Derivatives recommended for first trial.

## TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Acid anhydride	Boiling point,	Melting point,		Density	A	cıd	Amide	Antiide	p-Toluidide	2- Naphthyl-	Miscellaneous
140	Acid annydride	°C,	°C	n <sub>D</sub>	g/ml	ВР	M P	Aimde	Aimide	p-10tuidide	amide	Miscenaneous
1	Trifluoroacetic	39		1 26925	1 49025	72		75	88			
2	Perfluoropropionic	72		1 27325	1 57125	96		95	1		ĺ	
3	Perfluoro-n-butyric	108	1	1 28520	1 66520	120	i	105	93			l
4	Acetic	140	-73	1 390420	1 081120	118	16	82	114	153	l	
5	n-Propionic	167	<b>-45</b>	1 40420	1 017 15	141	i	81	106	126 (124)	i	ľ
6	Perfluoro-n-caproic (Perfluoro-n-hexanoic)	176		1 29520	1 76945	157		117				
7	Isobutyric	182			0 95717	154		128	105	107		
8	Pivalic (Trimethylacetic)	190				164	35	154	129	120	ŀ	
9	n-Butyric	198			0 97815	162	1	115	96	75 (73)	125	
10	Citraconic (Methylmaleic)	214	7-8	1 47121 5	1 23845		92d	185-7 (di)	175 (di)			
11	Isovaleric	215				176		135 (137)		107	138	
12	Dichloroacetic	216d				194		98	118	153		
13	Valeric (Pentanoic)	218			0 92217	186		106	63	74	112	
14	Crotonic	248		1 474520	1 039720	189	72	161 (158)	118 (115)	132		
15	Caproic (n-Hexanoic)	254-7 (245)		1 429720	0 9220	205		100	95 (92)	75 (73)	107	
16	n-Heptanoic	258		1 433515	0 917540	223		96	70 (65)	81	101	
17	α-Methylglutaric	272-5					79		175 6 (di) mono (2 forms) 114 or 100	174 5 (d1) mono (2 forms) 126 or 98-9	227-8 (dt), 115-9 (mono)	
18	Caprylic (n-Octanoic)	280-5	-1	1 43617	0 906517	239	16	110 (106)	57 (55)	70	103	
19	cis-Hexahydroisophthalic	304					187 9	` ′	298-9 (di)			1

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

#### TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

### a) Liquids 2)(Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amide derivative)\*

		Boiling	Melting point,		Density	Ac	eid	Amide	Anilide	p-Toluidide	2- Naphthyl-	Miscellaneous
No.	Acid anhydride	point, *C	°C	n <sub>D</sub>	g/ml	B.P.	M.P.	Aillide	Aiiiide	p Totaldide	amide	
1	DL-α-Bromobutyric	148- 52 <sup>10</sup>				12725	-4	112				4-Nitrophenyl ester, 48-9; 2-Naphthyl ester, 54
2	DL-α-Bromopropionic	120 <sup>5</sup> (123– 4 <sup>10</sup> )				204	26	123				

<sup>\*</sup>Derivative data given in order: m.p., crystal color, solvent from which crystallized.

### TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES b) Solids (Listed in order of increasing m.p.)\*

		Melting			Acıd				2	
No	Acid anhydride	point,	point, °C	ВP	M P	Amide	Anilide	p-Toluidide	Naphthyl- amide	Miscellaneous
1	Oleic	22			16	76	41	43	169	
2	Capric (n-Decanoic)	24	]	268 70	1	108, 98	70	78	104	D <sub>D</sub> <sup>70</sup> 0 8596, n <sub>D</sub> <sup>70</sup> 1 4234
3	β-Ethyl-β-methylglutaric	25	18520	J	87	j	105 (mono)		j	1-Naphthylamide, 126
4	Hexahydrobenzoic	25	280-3	232	29-30	185-6		ł		
5	α,α-Dimethylsuccinic (unsym - Dimethylsuccinic)	29	220		141					$\alpha$ -Me ester, 41 $\beta$ Me ester, 52, Anil, 87
6	cis-Hexahydrophthalic	32	14518		192					Conc HCi at 180 → trans form, 221
7	DL-Methylsuccinic	37	244-8		115 (112)	225 (dı)	123, chl (mono), 159 et, ac, (mono)	164 (mono)	155 (mono)	Anil, 109–10
8	n-Undecanoic (n-Hendecanoic)	37		284	30	103, 99	71	80		
9	2-Methylbenzoic (o-Toluic)	39	ĺ	l	104 5	143	125	144		
10	β-Methylglutaric	41	276-8		87		200 (di) 121 (117) (mono)	mono 135	143 (mono)	
11	Bromoacetic	41-2		208	50	91	131		134	
12	Lauric (n-Dodecanoic)	42		299	44 (42)	110, 100	78	87	106	
13	Benzoic	42	360	ļ	122	130	163	158		
14	trans-α,β-Dimethylsuccinic	43			198 (208)	238 (di) 165 7 (mono)				Imide, 78
15	Iodoacetic	46		ĺ	83	95	143 4			,
16	Chloroacetic	46		189	63	121	134	162	117-8	
17	n-Tridecanoic	50		312	44	100	80	88		
18	DL-Phenylsuccinic	54	204- 6 <sup>22</sup>		168	209 10 (dt) 158-9 (α ) 144 5 (β-)	222 (dι) 175 (α-) 170-1 (β-)	175 (α-) 168 9 (β-)		Imide, 90
19	Myristic (n-Tetradecanoic)	54		20216	54	107,103	84	93	108	D <sub>4</sub> ° 0 8502, n <sub>D</sub> ° 1 4335
20	Glutaric	56		20020	97	di 175 6	224	218		_
21	Maleic	56, 52-4	198		130	181 (172) (mono) 266 (di)	173-5 (mono) 187 (di)	di 142		
22	Suberic (dimer) (Octanedioic)	56-7			144 (141)	127 (mono) 217 (di)	128 (mono) 186 (di)	dı 218		
23	α-Bromoisobutyric	63-5		198- 200	48-9	148	83	92	135	1-Naphthylamide, 116
24	Palmitic (n-Hexadecanoic)	64		22216	63	106 7	90	98	109	D <sub>4</sub> <sup>70</sup> 0 847, n <sub>D</sub> <sup>70</sup> 1 4357
25	Margaric (n-Heptadecanoic)	67		231 16	61	108		j		
26	Itaconic (Methylenesuccinic)	67-8			165	di 192	190, 185	1		
27	Sebacic (dimer) (Decanedioic)	68		24315	133	210 (di) 170 (mono)	1 '	, ,		
	Stearic (n-Octadecanoic)	70	ĺĺ		70	109	95	102	112	
	3-Methylbenzoic (m-Toluic)	71			111 3	94	126	118		Hydrazide, 97
	Phenylacetic	72			76-7	156	118	136	159	
	2-Bromobenzoic	75-6			150	155 6				Hydrazide, 153
	Arachidic (n-Eicosanoic)	77-8			77	108-9	92	96	112	
	2-Chlorobenzoic	79			142, 140	142	114, 118	131		
34	cis-α-Methylglutaconic	85			118		148 (mono)		Į	Mana Fr. 1 22
	cis-β-Methylglutaconic cis-α,β-Dimethylsuccinic	86 87		:	147-9 129,122	148 9 (mono)	143 (mono) 222 (dı)			Mono-Et ester, 73 Imide, 111, 101, Anil, 146
37	3,5-Dichlorophthalic	89			164	244 (dı)				Imide, 208, N-Phenyl- imide, 150
38	4-Methylphthalic	92	295		152	188 (dı)			}	Imide, 196
	3-Chlorobenzoic	95	ĺ	ſ	158, 155	134	122		-	
	4-Methylbenzoic (p-Toluic)	95			179 80	160	145	160		
40	- · · · · · · · · · · · · · · · · · · ·					167-8	180			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

		Melting			Acid	T			2-	
No	Acid anhydride	point,	point,	ВP	M P	Amide	Anilide	p-Toluidide	Naphthyl- amide	Miscellaneous
42	4-Chlorophthalic	99			157					Imide, 210-11, Di-Me
42	A-tata (A Mash and and an	99			184-6	167, 163	169 71	186		ester, 37, Anıl, 174
43 44	Anisic (4-Methoxybenzoic) DL-Benzylsuccinic	102		]	161	107, 103	109 /1	1180		Imide, 97 8, Dihydrazide,
77	DE-Benzyisacemic	1.02		1	1.0,					146
45	β-Phenylglutaric	105			140		171 (168)	154	ı	Imide, 174, Di-Me ester,
		1					(mono)	(mono)		86-7
46	1 ' "	108			198	202	170			Hydrazide, 124
47	α-Benzylcinnamic	108-9			158					Me ester, b p 278, Et
48	3,5-Dinitrobenzoic	109			204-5	183	234			ester, 38-9
49	4-Bromophthalic	113			173-5,	1103	234			Di-Me ester, 40
.,		109			166					
50	3-Methylphthalic	114-5,			157					Imide, 189-90
		110			1					
51	4-Nitrophthalic	119			165	200d	192	mono 172		
52	Succinic	120	261		186	157 (mono),	148 (mono)	180		
						260 (di)	230 (d1)	(mono) 255 (di)		
53	Nicotinic (3-Pyridine-	123			237 8	128	85	150		
-	carboxylic)	1.23			23, 0	1120	"	130		
54	3-Chlorophthalic	124 5			186					Imide, 118 20 (sealed
										tube)
55	1	125-6			182, 185					Imide, 224-4
56	3,4-Dimethylphthalic	126			201	l				Imide, 240-1, Methyl-
57	3-Bromophthalic	132-4			188, 178		1			imide, 98 9 Mono-Et ester, 127 8
58	Phthalic	132-4			206, 200	149 (mono)	170 (mono)	mono 160		Mono-El ester, 127 8
-		1.52			200, 200	220 (di)	253-5 (di)	1000		
59	3-lodobenzoic	134	l		187	187	,			Me ester, 54-5
	2-Naphthoic (β-Naphthoic)	135			184	192-3	171-2	192		
	2-Nitrobenzoic	135			146	176	155			
62	i '	136			133	148	151, 153	168		
63	trans-DL-Hexahydrophthalic	140			221	mono 196	ŀ			Mono-Me ester, 96,
64		141	ĺĺ		180-1	230 (2-),	231	1 1		D <sub>1</sub> -Me ester, 33 α-Me ester 96 8 2-Me
0-1	phenylacetic)	1.41			100-1	185 (α-)	231			ester, 143 5, α-Et ester,
	,,					100 (11)				107 8, Imide, 233
65	1-Naphthoic (α-Naphthoic)	146			162	202	163			Piperidide, 85-7
66	3-Bromobenzoic	148-9	}		155	155				Hydrazide, 151
67	3-Iodophthalic	159 61			206					Dı-Me, ester, 89, Dı-Et
	2.4 District	1,46								ester, 70, Imide, 238
-	2,4-Dinitrobenzoic 3-Nitrobenzoic	160 160,			183 140	203 143	154			
09	5-1 THE OBERZOIC	163	J		140	143	154	162		
70	3-Nitrophthalic	162			218	201 (dı)	234 (dı)	226 (dı)		
	3,5-Dinitrophthalic	163-4,			226	```	(,	(,		Et ester, 187, Di-Et
		161						] [		ester, 73
	4,5-Dichlorophthalic		313		200, 188					Mono-Et ester, 133 4
	4-Nitrobenzoic	189	1		241			204, 192		
	4-Chlorobenzoic 3,6-Dichlorophthalic	194 194-5	339		240 194-5	179, 170	194			Mono-Et ester, 130 1
"	2,0-Dictior opinitalic	174-3	227		174-3					Di-Et ester, 60, Imide,
l										242, Anil, 191
76	3,4-Di-iodophthalic	198	- 1		212-3					Anil, 270
77	$\beta$ -Phenylglutaconic	206			154-5	138 (mono)	174 (mono)	184		Mono-Et ester, 78,
						]		(mono)		Imide, 256-7
78	4,5-Dimethylphthalic	208	J		123,196					Methylimide, 150,
ŀ		1 1	1							Ethylimide, 89

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

# TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Acid anhydride	Melting point,	Boiling point,		Acıd	Amide	Anilide	p-Toluidide	2- Naphthyl-	Miscellaneous
NO	Acid annyunde	,C	*C	ВP	МР	Ainde	Aimide	p-Totaldide	amide	Miscenaneous
79	2,2'-Diphenic	217			229	191 (mono) 212 (dı)	176 (mono) 230 (d1)	:		H <sub>2</sub> SO <sub>4</sub> at 100-120 → Fluorenone-4-carboxylic acid, 227
80	4-Bromobenzoic	218			251	189	197	[		,
81	D-Camphoric	221			188	177 (mono) 193 (di)	209 (204) (mono), 226 (di)	α 212-4, β 190-6		
82	4-Iodobenzoic	228			270, 267	217 8				Me ester, 114
83	Tetrachlorophthalic	256, 249			250 d					Mono-Me ester, 142, Mono-Et ester, 94 5, Imide, 338-9, 2-Naphthylimide, 287, Anil, 268-9
84	1,8-Naphthalenedicarboxylic	274			274		250 82(di)			Heat with aq NH <sub>3</sub> → 1,8-Naphthalimide, 300 N-Phenylimide, 202 Di-Me ester, 102 3
85	Tetrabromophthalic	280			266				ı	Mono-Me ester, 267, Imide, > 380, yel, Anil, 279-80, p-Tolil, 280, 2-Naphthylimide, 306-8
86	Tetraiodophthalic	318, 325, yel			324 7					Mono-Me ester, 298

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE XV**

Hydrolysis of amide or imide to the corresponding carboxylic acid and amine \*

RCONHR' + 
$$H_2O$$
 +  $HCI \rightarrow RCOOH$  +  $NH_3R'^+CI^-$ 
Acid  $\downarrow OH^ NH_2R'$ 
Amine

RCONHR' +  $NaOH \rightarrow RCOONa$  +  $NH_2R'$ 
 $\downarrow H^+$ 
Amine

RCOOH
Acid

From the amide with aqueous hydrochloric acid

For directions and examples see Cheronis, pp. 607, 608, Vogel, pp. 404, 808

From the amide with 85% or 100% phosphoric acid

See Cheronis, p 609, G Berger and S C J Olivier, Rec Trav chim, 46, 600 (1927), W M Dehn and K E Jackson, J Amer Chem Soc, 55, 4284 (1933)

From the amide with 70% sulfuric acid

See Wild, p 193

From the amide with aqueous sodium hydroxide

See Cheronis, p 609, Vogel, pp 404, 799, Wild, p 193

NOTE For directions and examples for preparation of derivatives of carboxylic acids formed on hydrolysis of amides and imides see explanations and references to Tables XII, XIII and XIV, p. 186, 187, 188, 189

For directions and examples for preparation of derivatives of amines formed on hydrolysis of amides and imides see explanations and references to Table XVIII, p. 291, 292, 293, 294

#### N-Xanthylamides \*

RCONH<sub>2</sub> + 
$$H_{2}O$$

N-Xanthylamide

From the amide with xanthydrol in glacial acetic acid

For directions and examples see Cheronis, p 610, Linstead, p 66, Shriner, p 222, Vogel, p 405, Wild, p 195, R F Phillips and B M Pitt, J Amer Chem Soc, 65, 1355 (1943), W Andriani, Rec Trav chim, 35, 180 (1916)

From the amide with xanthydrol in ethanol-water-acetic acid mixture

See Shriner, p 222, Wild, p 195, R F Phillips and B M Pitt, J Amer Chem Soc, 65, 1355 (1943)

Hg salt (Hg derivative) \*

From the amide with mercuric oxide in methanol or ethanol

For directions and examples see Cheronis, pp 610, 611, Wild, p 197, J W Williams, W T Rainey and R S Leopold, J Amer Chem Soc, 64, 1738 (1942)

From the amide with mercuric oxide in water

See Vogel, p 405

From the amide with yellow mercuric oxide without solvent

See Cheronis, p 611, Wild, p 196, J W Williams, W T Rainey and R S Leopold, J Amer Chem Soc, 64, 1738 (1942)

Oxalate

$$RCONH_2 + (COOH)_2 \rightarrow RCONH_2 \cdot (COOH)_2$$

Amude oxalate

From the amide with anhydrous oxalic acid in the presence of ethyl acetate

\*Derivatives recommended for first trial

#### EXPLANATIONS AND REFERENCES TO TABLE XV (Continued)

For directions and examples see: Cheronis, p. 611; Wild, p. 196; C. A. MacKenzie and W. T. Rawles, Ind. Eng. Chem., Anal. Ed., 12, 737 (1940).

N-Acylphthalimide (Phthalimide derivative).

From the amide with phthaloyl chloride in toluene or without solvent.

For directions and examples see: Cheronis, p. 611; T. W. Evans and W. M. Dehn, J. Amer. Chem. Soc., 51, 3651 (1929).

<sup>\*</sup>Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES a) Liquids (Listed in order of increasing b.p.)\*

No	Name		Melting point, *C	n 20	D₽	Derived acid				Derived amine				
						M.P., °C	BP, °C	p- Nitro benzyl ester	p- Bromo- phenacyl ester	M.P., °C	BP, °C	Acet- amide	Benz- amide	Miscellaneous
1	N,N-Dimethylformamide	153, 76 <sup>39</sup>	-61	1 4293824	0 9484224	8 4	100 7	31	140, 135		7		41	
2	N,N-Diethylformamide	176-8, 6815			0 90816	8 4	100 7	31	140, 135		56		42	
3	N-Methylformamide	180-5, 131 <sup>90</sup>	-38, -54	1 431025	1 01119		100 7		140, 135		-6	28	80	
4	Formamide	193, 195d	2 55			8 4	100 7	31	140, 135		NH <sub>3</sub>			Xanthyl deriv , 184, Oxalate, 107 4 7 7
5	N-Ethylformamide	197 9			0 95221	8 4	100 7	31	140, 135		16 5, 19		71	
6	N-Formylpiperidine (Form-N-piperidide)	222				8 4	100 7	31	140, 135		106		48	
7	N-Acetylpiperidine (Aceto-N-piperidide)	226		:		166	1182	78	86 0		106		48	-
8	N-Methylformanilide	243-4, 249- 51, 128- 915	12 5		1 092823	8 4	100 7	31	140, 135		196	102	63	
9	N-Ethylformanilide	258 <sup>728</sup> , 123 <sup>11</sup>			1 0549	8 4	100 7	31	140, 135		205	54	60	
10	N-Propylformanilide	267 <sup>731</sup> (cor)			1 044 16	8 4	100 7	31	140, 135		222	47		
11	N-IsobutyIformanilide	274 <sup>731</sup> (cor)				8 4	100 7	31	140, 135		227			
12	N-Isoamylformanilide	285- 6 <sup>728</sup>			1 00416	8 4	100 7	31	140, 135		254 5 (cor)			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Xan thyl amide			Deriv						
				MP °C	BP °C	p Nitro benzyl ester	p Bromo phenacyl ester	мР,℃	вр °С	Acet amide	Benz amide	Miscellaneous
1	n-Butyranılıde	35		5 5 8	162 5 164		63		184	114	160	
2	Oleanilide	41		α 13 36	250		40 46		184	114	160	1
				β 16 25								
				1	heated							
		1	]	l	steam) 2165			1		ļ		1
2	N-Benzpiperidide (N-Benzoyl	48		122 4	249	89	1190		106		48	
,	piperidine)	<b>*</b> °		122 4	249	07	1170		100		70	
4	Ethyl urethane (Ethyl	49 48	169		l		Į.	N	H <sub>3</sub>	Į.	1	
	carbamate)	1			Ì		1		1	1	1	
5	Formanilide	50 47		8 4	100 7	31	140 135		184	114	160	B p 271 Benzyl chloride → benzyl form anilide 48
6	Malonic acid monoamide	50		134 8 9		dı 855		N	Н <sub>3</sub>			
_	(Malonamic acid)			<b>.</b>		ļ			Į.			
7	N-Propylacetanilide	50		166	118 2	78	86 0			47		
8	Difluoroacetamide	52 53		-39	134 5 203 35		72	^	H₃   184 5	1,0	100	
10	N-Benzyl-n-caproamide Phenyl urethane (Phenyl	53		-39	203 33		1/2		184	60 114	105 160	
	carbamate)	133	1				1		104	' ' '	100	
11	Methyl urethane (Methyl	54 52	193	ł		l		N	H <sub>3</sub>	Ì		
	carbamate)				}		1		1			1
12	N-Ethylacetamlide	54		16 6	118 2	78	86 0	1	205	54	60	Bp 249
13	n Butyl urethane (n Butyl carbamate)	54						1	H <sub>3</sub>			
14		54	1	- 30	176 5	68 0	135 137	1	1184 5	60	105	ł
15		54		]			1		H <sub>3</sub>			
16	Isobutyl urethane (Isobutyl	55	148				1	_ ^	<b>H</b> 3			
17	carbamate) N-Methyl-2-acetotoluidide	56		16 6	118 2	78	86 0	ł	208	56	66	-
18	Carprylanilide	57 55	]	16 3	237	1,0	67 4		184	114	160	
	Carpi yianiiiiac	1	l	1.00	239 3	1	1	İ				
19	Pelargonamilide	57	1	12 3	254 4		68 5	1	184	114	160	
20	N-Benzylacetanılıde	58		16 6	118 2	78	860	37	298	58	107	
21	,	58			204 203	į	1		184	114	160	
22	d l-Lactanilide	59		18	12215		1128		184	114	160	
23	•	60	l	122 4	249	89	1190	١.	205	54	60	Ĭ
24	n-Propyl urethane (n Propyl carbamate)	60						'	IH₃ I			
25	N-Benzylformamide	60		8 4	100 7	31	140 135	]	184 5	60	105	
26	I -	61		166	118 2	78	86 0		184 5	60	105	
	Propiolamide	61-2		18	144d			N	H <sub>3</sub>			
	n-Valeranılıde	63		- 34 5	186 4	[	75		184	114	160	
••	(n-Pentananilide)							1	I			
29	Isoamyl urethane (Isoamyl	64	145		1	}	1	l N	lH₃	1	1	1
30	carbamate) Erucanılıde	45 55		33 4	26415	]	62 5		104	114	160	
	3-Acetotoluidide (N Acetyl-m	65, 55	J	16 6	118 2	78	86 0		184	65	125	
٠.	toluidine)	""		1.00	1102	1	"		203	"	`~	
32	N-Methyl-3-acetotoluidide	66	1	16 6	118 2	78	86 0		206 7	66	125	
	Ethyl oxanilate	66 7			1 -	•			184	114	160	
34	Benzindole	68		122 4	249	89	119	52	253	157 8	68	
	Heptananılıde	70, 65	)	-7 46	223	]	72		184	114	160	)
36	Capranilide (n-Decananilide)	70		31 3	268 7		60		184	114	160	
37	n-Undecananilide	71		28 5	280, 284		68 2		184	114	160	
	(n Hendecananılıde)	1	1	α 13 4								
		1		β 16 3					1			1

<sup>\*</sup>Derivative data given in order in p , crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			V		Derive	d acid			Deriv	ed amine	_	
No.	Name	Melting point, °C	Xan- thyl- amide	M.P., *C	B.P., *C	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	M.P., °C	B.P., °C	Acet- amide	Benz- amide	Miscellaneous
38	2-Methylhexanamide	72			209.6		1	NI	Нз			
39	N,N-Diphenylformamide	73		8.4	100.7	31	140; 135	53-4		101	180	
40	Vinylacetanilide			- 35	169; 163			1	184	114	160	
41	Oleamide	76		α: 13.36 β: 16.25	250 (super- heated steam); 216 <sup>5</sup>		40-6	IN	H <sub>3</sub>			
42	Thioacetanilide	76	l		93			1	184	114	150	
43	Tiglamide	76		64.5-5.0	198.5	64	68	NI			<b> </b>	
					(cor.)			1 1				
44	Tiglanilide	77		64.5-5.0	198.5 (cor.)	64	68		184	114	160	
45	4-Methylhexananilide	77			217-8254				184	114	160	
	Lauranilide (Dodecan- anilide)	78		44; 42	299		76		184	114	160	
	d,l-2,3-Dimethylbutananilide	78		- 1.5	191.7				184	114	160	]
48	Pentadecananilide	78		52.3	21216		77.2	·····	184	114	160	
49	d,l-Lactamide	78.5- 9.0; 76		18	12215	(cor.)	112.8	NH	١,			
50	Transbrassidanilide	79		59.7	25610	 	94.2		184	114	160	
	2-Acetophenetidide (N-Acetyl-	79		16.6	118.2	78	86.0		229	79	104	
	o-phenetidine)											
		79.6; 80			195-6			NH			· · · · · ·	
	Tridecananilide	80		43; 41.6	312;17710		75.0		184	114	160	
	d,l-α-Chloropropionamide	80			186			NF	-	•••••		
55	Propionamide	81;77	214; 211	- 20.8	141	31	63.4	N F	13			Mercury deriv., 201; Oxalate, 80.8-1.0
56	Acetamide	82	245; 238- 40	16.6	118.2	78	86.0	N H	13	•••••		Mercury deriv., 196-7; Oxalate: 127.3; Phthali- mide, 135-6
57	Ethoxyacetamide	82			206-7		104.8	NH	١,			
58	N-Methyl-4-acetotoluidide	83		16.6	118.2	78	86.0		210	83		
59	α-Bromoisobutyranilide	83		489	198-200				184	114	160	
60	γ-Phenylbutyramide	84		52	290		[	NH	٠ .			
	Myristanilide	84		53.9	21216		81			114	160	
62	Acrylamide	85		13	141; 140			NH		• • • • • • •		
63 64	Allylurea	85 85								114	160	
	d,l-α-Ethylphenylacetamide (α-Phenylbutyramide)	86; 83			270			NH	· · · · · · · · · · · · · · · · · · ·			
66	4-n-Propylacetanilide	87		16.6	118.2	78	86.0		225	87	115	
67	α-Undecylenamide (α-Hendecyleneamide)	87		24.5	275			N'H I	۱,			
	Propiolanilide	87		18	144d.					114	160	
	3-Bromoacetanilide	87	1	16.6	118.2	78	86.0	1		87	120; 136	
	d,l-3-Methylpentananilide	87		-41.6	197.5			•	- 1	114	160	
71	n-Butyl oxamate	88		189.5 (anh.); 101(+		di: 204		NH 	3			•••••
72	2-Chloroacetanilide	88		1H₂O) 16.6	118.2	78	86.0			87	99	
73	D-Chaulmoogranilide	89		68.5	247-820				207	114	160	
	Palmitanilide	90	1	62.7	22216	42.5	86;82			114	160	
	N-Phenylmaleimide	91		130		di: 91	168-70;	1		114	160	
						(cor.)	190	1				
		1	i									

<sup>\*</sup>Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

		1			Derive	ed acid			_	Deriv	ed amine		
No	Name	Melting	Xan	<b></b>	T	p-Nitro-	p-Bromo		_		Γ		
140	Name	point °C	thyl amide	MP °C	BP °C	benzyl ester	phenacyl ester	MP '	°C	вр °С	Acet amide	Benz amide	Miscellaneous
76	Bromoacetamide	91		50	208	88			N	Н 3			
77	α-Phenylpropionamide	92	158	1	265					H <sub>3</sub>			
78	Isopropyl urethane	92								33			
	(Isopropyl carbamate)	i				1		l			ł	ì	
79	Arachidanilide	92		77 75	2041		89		ı	184	114	160	
80	d / α Chloropropionanilide	92			186					184	114	160	
81	2,2-Dimethylbutananilide	92		- 15 0	187 190				Į	184	114	160	
82	2-Nitroacetanilide	92 94		16 6	118 2	78	86 0	71	- 1		92 94	98 110	
83	Maleimide	93		130		di 91	168 70		N.	H <sub>3</sub>			
84	Elaidamide	93 4		44 5 51	23415	(cor)	190 65		NI.	Н,			
85	Transbrassidamide	94	ĺ	59 7	25610	[	94 2			H <sub>3</sub>		1	•
86	2-Ethylpentananilide	94		,	209		7.2		١,٠	184	114	160	
87	N-Methyl-N-(1-naphthyl)	94		16 6	118 2	78	86 0			294	94 5	121	
88	n-Caproamlide (n Hexananilide)	95 92		-39	205 35		72			184	114	160	
89	N-Butyranilide	95		-55 -8	162 5 164	35	63			184	114	160	
90	N-Benzylpalmıtamıde	95		62 7	22216	42 5	86 82			184 5	60	105	
91	Azelaic acid monoamide	95		106 5	> 360 sl d 23715	di 438	di 130 6	]	Ni I	Н 3			
92	d l-2-Methylpentanamlide	95			195 6					184	114	160	
93	Iodoacetamide	95		83		l	1			H <sub>3</sub>			
94	Stearanilide	95		70 1 69 6			92		•	184	114	160	]
95	Heptanamide	96	154 5	-746	223 0		72	•		H <sub>3</sub>			-
96 97	Trichlorolactamide Semicarbazide	96 96		124			ļ	14		H <sub>3</sub>	mono		Gives semicar
97	Semicardazide	96						14		1133	67 di (sym) 138	mono 172 5 di (sym) 241	bazones with aldehydes and ketones
98	3-Toluamide	97, 94		111 3,	236, subl	86 6	108					(cor)	Mercury deriv,
99	Trichloroacetanilide	97, 94		110 1 57 8	197 5	80				184	114	160	200
100	3-A cetophenetidide	97, 94		166	118 2	78	86 0		J	248	37	103	1
101	N-Benzylstearamide	97		70 1 69 6	1102	1′°	92		۱	184 5	60	105	[
102	Glycollanilide	97		78 9 80		106 8	138			184	114	160	
103	Methoxyacetamide	97			204 203			]	•	13			
104	Hydrocinnamanilide	98, 96		48 7, 40	279 80	36 3	104		Ī	184	114	160	
	(β Phenylpropionanilide)				(cor)	}							
105	$\alpha$ -Hydroxyisobutyramide	98		79	212	80 5	98	] 1	N	1,			
	Dichloroacetamide	98, subl		5–6	194	}	99	] 1		13			
	2-Methylhexananilide	98			209 6				•	184	114	160	
	4-Methylhexanamide	98 99, 94			217 8745	70	l.,		N	13	00	140	
	4-Methyl-2-nitroacetanilide Capramide (n-Decanamide)	99, 94	148	16 6 31 3	118 2 268 7	78	86 0 67 0	117	i Ni	1 <sub>3</sub>	99	148	
	2-Bromoacetanilide	99	140	16 6	118	78	86 0	32		250	<b>9</b> 9	116	
- 1	Phenoxyacetanilide	99		98 9,99	285d	, ,	148 5	32	- 1	184	114	160	
				100					ļ				
113	Pelargonamide	99	147 5 8 5	12 3	254 4		68 5	l :	Nj 	· 1 3			
114	$\alpha$ -Bromopropionanilide	99, 110		25 7	203 5					184	114	160	
115	n-Caproamide	100, 101	160	-39	203 35		72	1	Νŀ	ł,	:		Oxalate, 71 1- 3
	(n-Hexaneamide)		- 1				[ [		ļ	1			
116	Tridecanamide	100		43, 41 6	312, 177 <sup>10</sup>		75		N F				
117	Phenylpropiolamide	100, 109		136-7, subl		83			N F	J ,			

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

					Derived	acid	_		Derive	d amine		
No.	Name	Melting point, °C	Xan- thyl- amide	M.P., °C	B.P., *C	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	М.Р., °С	B.P., °C	Acet- amide	Benz- amide	Miscellaneous
118	N,N-Diphenylacetamide	101		16.6	118,2	78	86.0	53-4		101	180	
119 120	β-lodopropionamide N,N'-Diacetyltrimethylene- diamine	101 101		82; 85 16.6	118.2	78	86.0		H <sub>3</sub>   136	mono: 126;	mono: 140;	
121	Methylurea	101	230			<del> </del>			-6	di: 101 28	di: 147 80	Picrate, 127d.
122	Phenoxyacetamide	101		98-9;	285d.		148.5	N	Н,			
123	N-Methylacetanilide	102	•••••	99-100 16.6	118.2	78	86.0		196	102	63	B.p. 237; Conc. HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → p-Nitro deriv., 153
124	Levulinanilide	102		33-5, deliq.	2456	61	84		184	114	160	
125	Pentadecanamide	102		52.3	21216	39.5-40 (cor.)	77.2	N	H <sub>3</sub>		· · · · · · · · · · · · · · · · · · ·	
126	Isocrotonamide	102		15	169		81	1	H <sub>3</sub>			
127	Isocrotonanilide	102		15	169 280-4		81 68.2		•	114	160	
128	n-Undecanamide (n-Hendecanamide)	103; 99	•••••	28.5; α:13.4; β:16.3	200-4		00.2	^	H <sub>3</sub>			
129	3-Benzophenetidide (N-Benzoyl-m-phenetidine)	103		122.4	249	89	119		248	97	103	
130	N,N-Dicyclohexylacetamide	103		16.6	118.2	78	86.0	20	225 sl. d.	103	153	
131	3,4-Dimethylbenzanilide			166; 164		1	1:::	{	184	114	160	
132	2-Benzophenetidide (N-Benzoyl-o-phenetidine)	104		122.4	249	89	119		229	79	104	
133	Pyruvanilide	104, subl.		13.6	165d; 80 <sup>25</sup>				184	114	160	
134	N-Cyclohexylacetamide	104		16.6	118.2	78	86.0	]	134	104	149	
135	2-n-Propylacetanilide	104-5		16.6	118.2	78	86.0		222-4	104-5	119	
136	2-Ethylpentanamide			46.1	209		76.8	N	H <sub>3</sub>	114	160	
137 138	Isobutyranilide	105		-46.1 16.6	154.7 118.2	78	86.0		1	105	126	
139	4-n-Butylacetanilide Acrylanilide	105		13	141; 140				184	1114	160	
140	β-Phenylpropionamide	105	189	48.7; 40	279-80	36.3	104	N	Н,			
	(Hydrocinnamamide)				(cor.)	ĺ	1		1	ĺ	1	[
141	Propionanilide	106; 103	142	-20.8	22216	42.5	86; 82		184 NH <sub>3</sub>	114	160	Conc. HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → p-Nitro deriv., 182
142	Palmitamide	106	172	122.4	249	89	119	ł	184-5	60	105	
143	D-Chaulmoogramide	106	l	68.5	247-820	Ĭ		,	IH <sub>3</sub>			
145	sym-Dimethylurea	106	<b> </b>				<b></b>	1	-6	28	80	
146	n-Valeramide (n-Pentanamide).	106	167	-34.5	186.4	ļ	75		H <sub>3</sub>			Oxalate, 61.14
147	Myristamide	107; 103	ĺ	53.9	21216		81	1	lH,			
148	N-Benzylbenzanilide			122.4	249	89 48.5-9.0	119	37	298   H	58	107	
149	Margaramide (Heptadecanamide)	108		61.2	231 16	(cor.)	02.0		H,     H			
150	Thioacetamide	I .		93 31-2	167–9		1	1	iH, iH,			
151 152	Levulinamide	1		33-5,	245-6	61	84		iH,			
153	Azelaic acid monoanilide	108		deliq. 106.5	> 360 sl. d.;	di: 143.8	di: 130.6	i	184	114	160	
154	Arachidamide	108-9		77; 75	237 <sup>15</sup> 204 <sup>1</sup>		89	N	  H,		<u> </u>	

<sup>\*</sup>Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

					Derived	d acıd			Deriv	ed amine		1
No	Name	Melting point, °C	Xan- thyl- amide	MP,°C	BP,°C	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	M P, °C	BP,°C	Acet- amide	Benz amide	Miscellaneous
155	Anthranilamide	109		147d				N	H <sub>3</sub>			
156	2-lodoacetanilide	109	]	16 6	118 2	78	86	61,58	]	109	139	
157	Pimelic acid monoanilide	109		104-5,	22315		di 136 6		184	114	160	
				subl								
158	Stearamide	109 109	139 41	70 1, 69 6		1	92		iH, iH,	ļ		
159 160	α-Methylhydrocinnamamide Lauramide (Dodecanamide)	170, 102		44, 42	299	}	76		iH <sub>3</sub>	}		
161	·	110, 108		16 3	237,	-	67.4	1	iH <sub>3</sub>			
	(n-Octanamide)	, ,			239 3					1		
162	Isovaleranilide	110		-30 0	176 5		68 0		184	114	160	
163	d l-2-Methylbutananilide	110			176-7,	:	55		184	114	160	
		l			174			_		1		
164	3-Nitrophenylacetamide	110 111		120 16 6	118 2	78	86 0		H <sub>3</sub> 210–1	111	147	
165 166	2-Ethylacetanilide β-Bromopropionamide	111		62 5	1102	<i>\</i> ′°	800		210-1  H <sub>3</sub>	1111	147	
167	3-Aminobenzamide	111		174d					iH <sub>3</sub>		İ	
168	2-Ethylbutanamide	112, 107		-31 8	195				H <sub>3</sub>			
169	4-Methylpentananilide	112, 110		-33	199 1752		77 3		184	174	160	
	(Isocaproanilide)								[			
170	d,l-2-Methylbutanamide .	112			176–7,	1	55	, n	iH,	]	ł	
171	2-A cetotoluidide	112		16 6	174 118 2	78	86 0	200		110 11	146	KMnO, →
1/1	2-Acetototalatae	112		100	1102	"	"	200		110 1	140	Acetylanthra-
												nilic acid, 185
172	d-Hydnocarpamide ( $lpha$ -Cyclo-	112-3		60 5				N	H <sub>3</sub>			
	pentylundecylamide)					ļ						
173 174	4-Aminobenzamide Acetanilide	114 114		118d 16 6	118 2	78	86 0	1	H <sub>3</sub>	114	160	B p 304, Conc
174	Acetaminue	(cor )		100	116 2	76	80 0		104	114	100	$HNO_3 + H_2SO_4 \rightarrow p$ -nitro deriv,
175	N-Benzylcrotonamide	114	_	72	189 (cor )	67 4	95-6		184-5	60	105	2.0
176	<u> </u>	114		189 5	, ,	dı 204			16 5,		71	
				(anh ), 101(+ 2H <sub>2</sub> O) (rapid htng )		106			19	ļ	1.00	
177 1 <b>7</b> 8	2-Chlorobenzanilide Dihydroacetic acid	114, 118 115		142, 140 109	270	106	106		184 184	114 114	160 160	
1/0	monoanilide	117		107	210				104	117	100	
	n-Butyramide	115	185-7	-5 5, -8	164		63		H <sub>3</sub>			Mercury deriv, 222-4, Oxalate, 65 9 6 2
	Methacrylamide	116	]	16	161		•	N	H <sub>3</sub>		1,00	
	$\alpha$ -Bromoisovaleranilide trans- $\alpha$ -Crotonanilide	116 118, 115		44 72, w	230d 189 (cor )	67.4	95-6		184 184	114 114	160 160	
	Phenylacetanilide	118, 113		76 5,	256 5	65	89		184	114	160	Conc HNO <sub>3</sub> →
.00	- non, non, non, non, non, non, non, non			subl	(cor)							2,4-dinitro- phenylacetic acid, 189
184	Dichloroacetanilide	118		5-6	194		99		184	114	160	
	N-Ethyl-4-nitroacetanılide	118		166	118 2	78	86 0	96		119	98	
186	Trimesic acid trianilide	118~		380 (сог)			tri 197		184	114	160	
ļ		20d					(sealed tube)					
187	3-lodoacetanilide	119		166	118 2	78	1 1	33, 27		119	157	
	Cyanoacetamide	120	222-3	66					н,			
						L	Ll				<u></u>	L

<sup>\*</sup>Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m. p.)\* (Continued)

		<u> </u>	T	<u> </u>	Derive	d acid		T	Deriv	ed amine		
No	Name	Melting	Xan thyl	-	I	p-Nitro	p-Bromo	<del>                                     </del>	T	Γ.	1 _	Miscellaneous
140	, tane	point °C	amide	мр℃	BP °C	benzyl ester	phenacyl ester	MP,°C	BP °C	Acet amide	Benz amide	
189	Glycolamide	120		78 9,80		106 8	138	N	IH <sub>3</sub>			
190	1 ·	120 1	159-60	<b>– 33</b>	199 1752		77 3	N	IH₃			
	(Isohexanamide)		,	ł			ļ					
191	Chloroacetamide	121	208 9	α613	189	ļ	104					
				$\beta$ 56 2, $\gamma$ 52 5								
192	2-Chlorophenoxyacetanılıde	121	ļ	145 6, w		İ			184	114	160	
193	Tribromoacetamide	122		131, 135	245d	İ		N	IH <sub>3</sub>			
194	Sebacic acid monoanilide	122		33, subi	243 15	di 73 5, 72 6	di 147		184	114	160	
195	3-Chlorobenzanılıde	122 5	ļ	158 155	1	107	116		184	114	160	
196	α-Bromopropionamide	125		25 7	203 5			N	H <sub>3</sub>			
197	Furanilide	123 5		133 4	230-2	133 5	138 5		184	114	160	
		i	]	132								
198	Pyruvamide	124		13 6	165d			N	IH₃			
199	3-Methylpentanamide	125		41.6	80 <sup>25</sup> 197 5		1		 			1
200	4-Chlorophenoxyacetanilide	125 125		-41 6 155 6	17/3		136	"	H₃   184	114	160	1
200	- Carot opinenox jacciaminac	1.23		w 158			1.30			***	1.00	
201	3-Benzotoluidide	125		122 4	249	89	1190		203	65	125	1
	(N Benzoyl m tołuidine)	1	'					1	l			
202	2-Toluanilide	125		104-5,	259731	90 7	57		184	114	160	
				107 8	l					120 /	1.00	
203	Acetyl-β-phenylhydrazine	125 6		166	118 2	78	86 0	19, 23	243	128, di 107	168, di 177	
204	Adipic acid monoamide	125-30		153 4	21615	106	154 5,		∤ lH₃	107	1	
20.	Aupre acia monoami-e	125 50		(cor)			152 6	-	1			1
205	Succinimide	126	245-7	185,	235d	di 88	di 211	l N	H <sub>3</sub>			
			1	182 8			1	l				
206	3-Toluanılıde	126		111-3, 110 1	263, subl	86 6	108		184	114	160	
207	Angelanilide	126		45-6	185 (cor )				184	114	160	
	β-Resorcylanilide (2,4-	126 7		213d	105 (601 )	188-9			184	114	160	
	Drhydroxybenzanilide)			(rapid							1.00	
	,			htng )					ŀ			
				216, 217								
209	2-Ethylbutananılıde	127,		-318	195				184	114	160	
210	Suberic acid monoamide	127 5 127	} ;	144 139		di 85	dı 1442	NI	l H₃			
210	Subtric acid invilvalmut	''-'		41		"	3, 144 2	"	<sub>3</sub>			
211	4-Methoxyacetanilide	127		16 6	1182	78	86 0	58	240	130 127	154, 157	
	Angelamide	127 8		45 6	185 (cor )			N	H <sub>3</sub>			
213	Phenylpropiolanilide	128, 126		136 7,		83			184	114	160	
[ ۱	Nivertinomido	120		subl 237-8					$ H_3 $			Вр 150 60 <sup>5 10-4</sup>
214	Nicotinamide	128 129,		237-8 subl				N	113			Chloroaurate,
		129,		Suoi								205, N-Ethyl,
- 1	: 	, 51										188-9, N
												ısopropyl, 184 6
215	Pivalanılıde	128		35 5	163 4		75–6		184	114	160	
		(cor ),										
3	C	132-3		144		dı 85	dı 144 2		184	114	160	
216	Suberic acid monoanilide	128-9		144, 139-41		ui 0)	41 144 2		104	. 1-7	100	
217	Isobutyramide	129, 127	210-1	-46 l	154 7		76 8	N	H <sub>3</sub>			
	2-Methoxybenzamide	129		100-1	200		113		H <sub>3</sub>			Mercury deriv,
- }	•	1.20					0.0	105				241
	2-Bromo-4-nitroacetanılıde	129		166	118 2			105 N	<u>.</u>	129	160	Maraus da
220	Benzamide	130, 129	222 5- 3 5,	122 4	249	89	119	N	П.3			Mercury deriv , 222, Phthali-
			224									mide, 168
				.,								11100, 100

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			Xan-		Deriveo	i acıd		[	Dern	ed amine		
No	Name	Melting point, °C	thyl- amide	MP,°C	BP,°C	p-Nitro benzyl ester	p Bromo- phenacyl ester	MP°C	BP °C	Acet amide	Benz amide	Miscellaneous
221 222	3,4-Dimethylbenzamide $\alpha,\beta$ -Dibromopropionamide	130 130, 133		166, 164 67 (stab ). 50 (un- stab )	16020				NH <sub>3</sub>			
223	Anthranilamlide	131	}	147	l	1	1	l	184	114	160	
224	Bromoacetanilide	131		50	208	88			184	114	160	
225	2-Methoxybenzanilide	131		100-1	200		113		184	114	160	
226	Nicotinanilide	bz, 85 (+ 2H <sub>2</sub> O), w, 265 (anh)		237 8, subl					184	114	160	
227	2,2-Dimethylbutanamide	132, 103		-150	187, 190	l	Į	ł	184	114	160	
228	d,l-2,3-Dimethylbutanamide	132		-15	191 7		ł	N	NH <sub>3</sub>			
229	3,3-Dimethylbutananilide	132		6 7	184, 9626				184	114	160	
230	3,3-Dimethylbutanamide	132		6 7	184, 96 <sup>26</sup>				NH 3			
231 232	2,5-Dichloroacetanilide Malonic acid monoanilide	132		16 6	118 2	78	86 0	50	184	132	120	1
233	Urea (Carbamide)	132 132 8	265, 274	134 8 9		di 85 5		۸	164   NH <sub>3</sub> 	114	160	Phthalimide, 188-90, Picrate, 148
234 235	2,4-Dimethylacetanilide Mesityleneamide (3,5- Dimethylbenzamide)	133, 130 133		16 6 16 6	118 2	78	86 0	N	217   H <sub>3</sub> 	133, 130	192	140
236	4-Isopropylbenzamide	133		177, al				N	Н <sub>3</sub>			1
237	α-Bromoisovaleramide	133		44	230d			1	NH3			
238	4-Chlorophenoxyacetamide  d l-Mandelamide	133		155-6, w,158		123-4	136		\H₃ 			
237	2 7-141 and claiming	(cor)		110		123-4		15	≀H₃ 			
240	N-(2-Naphthyl)acetamide	134		16 6	1182	78	86 0	112		132	162	Br <sub>2</sub> → 1-Bromo der <sub>1</sub> v , 140
241	3-Chlorobenzamide	134		158, 155		107	116		H <sub>3</sub> 			Mercury deriv, 245
242	Phenacetin (4-Aceto- phenetidide)	134		16 6	118 2	78	86 0	2 3	248 254	137	173	10%HNO <sub>3</sub> → 3-Nitro deriv, 103
243	Chloroacetanilide	134, 136–7		α 61 3, β 56 2, γ 52 5	189		104		184	114	160	
	2,3-Dimethylacetanilide	135		16 6	118 2	78	86 0		221-2	135	189	
	Isovaleramide	135, 136	182-3	-30 0	176 5		68 0	N	H <sub>3</sub>			
	Acetyl sahcylanilide	136		(rapid htng)	140d	90 5			184	114	160	
247	3-Bromobenzanilide	136		155		105	120		184	114	160	}
248	Salicylanilide	136		158 3 (subl at 76)		97-8	140		184	114	160	
249	lpha-Hydroxyisobutyranılide	136		79	212	80 5	98		184	114	160	
250	N,N-Diacetyltetramethyl- enediamine	137		16 6	118 2	78	86 0	27	159	dı 137	dı 177	
251	Benzo-2-iodonanilide (N-Benzoyl-o-10doaniline)	139		122 4 (subl at 100)	249	89	119	61, 58		109	139	
	3-Ethoxybenzamide	139		137					H 3			
	2,5-Dimethylacetanilide	139		16 6	118 2	78	86 0	15 5	213-5	139	140	
254	3-Ammobenzanilide	140		174d					184	114	160	}

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			Xan		Derived	acıd				Denve	ed amine		
No	Name	Melting point, °C	thyl- amide	мР,℃	BP,°C	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	мР,	·c I	ВР, ℃	Acet- amide	Benz- amide	Miscellaneous
255	2-Toluamide	140, 143	199 200 5	104-5, 107-8	259751	90 7	57		NI-	13			Mercury deriv,
256	Trichloroacetamide	141	1	57-8	197 5	80	ļ	l	NE	i,	ļ	ļ	
257	2-lodobenzanilide	141		162		111	143			184	114	160	
258	2-Bromobenzanılıde	141	i	150		110	102			184	114	160	
259	3-Tolylurea	142		ŀ					•	203	65	125	
260	2-Chlorobenzamide	142		142, 140		106	106		NH	13			
261	Salicylamide	142		158 3 (subl at 76)		97-8	140		NH	13			Mercury deriv, 190
262	Furamide	142-3	210	133 4, 132	230–2	133 5	138 5		NH 	i,			
263	3-Nitrobenzamide	143, 142	<b>!</b>	140	1	141	132	1	ΝH	I 3		1	1
	Iodoacetanilide	143-4		83	1					184	114	160	
	3,5-Dimethylacetanilide	144, 140		166	118 2	78	86	1	2	220	144, 140	136	
	2-Benzotoluidide (N-Benzoylo- o-toluidine)	144		122 4	249	89	119			200	110-11	146	KMnO₄ → Benzoylanthra- nilic acid, 177
	3-Nitrosalıcylamide	145 (hyd)		125					NH 	I <sub>3</sub>			
	2,4-Dichloroacetanılıde	145		166	118 2	78	86 0	63			145	177	
	$\alpha$ -d l-Phenylsuccinamide ( $\beta$ form)	145		167-8, 84 (anh )					NH 				
	4-Toluanilide	145, 148		179 80, 182 subl	275 (cor )		153			184	114	160	
[	Diethylmalonic acid monoamide	146		125		di 91			NH 				
	Cyclohexancarboxanilide (Hexahydrobenzanilide)	146, 131		30–1	233					184	114	160	
273	Phenylurea N,N'-Dibenzoyltrimethylene- diamine	147 147	225	122 4	249	89	119		- 1	184 136	114 mono 126, di 101	160 mono 140, di 147	
275	Benzo-2-ethylanilide (N-Benzoyl-o-ethylaniline)	147		122 4	249	89	119		1	210-11		147	
276	2,4,6-Trichloroacetanslide	148		166	118 2	78	86 0	78	1		148	172	1
	α-Bromoisobutyramide	148		48-9	198-200				ΝH	<sub>I</sub> ,			
	Cinnamamide	148, 142		133	300	1168	145 6		ΝH	-			
	Succinic acid monoanilide	148 5		185, 182 8	235 d	dı 88	di 211			184	114	160	
281	N-Cyclohexybenzamide Benzylurea	149 149		122 4	249	89	119		1		104 60	149 105	
282	Phthalic acid monoamide (Phthalamic acid)	149		200-6, 197 (sealed tube), 230 (rapid htng)		di 155 5	di 1528	]	NH     	3			
	eta-Benzoylpropionanilide	150, 145		116	,		]		1	184	114	160	
	Ethylmalonic acid monoanilide	150	1	111		75			1	184	114	160	
285	2-Chlorophenoxyacetamide	150		145-6, w				1	ΝΉ				
	Adipic acid monoanilide	151 3		153-4	21615	106	154 5,			184	114	160	
287	Cinnamanilide .	151, 153		(cor) 133	300	1168	152 6 145 6		1	184	114	160	Acıd KMnO₄ → Benzoic acıd,

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			Xan-		Derived	d acıd			Deriv	ed amine		
No	Name	Melting point, °C	thyl amide	MP,°C	BP,°C	p Nitro benzyl ester	p-Bromo phenacyl ester	мр,℃	BP,°C	Acet- amide	Benz- amide	Miscellaneous
288	4-Fluoroacetanilide	152		166	118 2	78	86 0	-1	186	152	185	
289	d l-Mandelanilide	152		118		123 4			184	114	160	
290	4-Acetoluidide (N-Acetyl-p-toluidine)	153, 147		16 6	118 2	78	86 0	45	200	147	158	KMnO <sub>4</sub> → 4- Acetamido- benzoic acid, 256, Br <sub>2</sub> → 3- Bromo deriv, 117
291	N-Methyl-4-nitroacetanilide	153		166	118 2	78	86 0	152		153	112	
292	Veratranilıde	154		181	1				184	114	160	
293	4-Fluorobenzamide	154		182, 182 6				N	H <sub>3</sub> 		1	
294	3-Nitrobenzanilide	154		140		141	132		184	114	160	
295	Benzilamide	154–5, 155		150		99 5	152		H <sub>3</sub>			
	3-Nitrosalicylamide	155, 145		125 (+ H <sub>2</sub> O)					H <sub>3</sub>			
	2,5-Dichlorobenzamide	155		153				1	H <sub>3</sub>			١.,
	2-Bromobenzamide	155		150		110	102	N	H <sub>3</sub>			Mercury deriv, 242
299	Dibenzylacetanilide	155		89					184	114	160	
300	2-Nitrobenzanilide	155		146	}	112	107		184	114	160	<b>1</b>
301	3-Bromobenzamide	155		155		105	120	N	H <sub>3</sub>			Mercury deriv, 235
302	N-(1-Naphthyl) acetanilide	155, 159 6		131, 135					184	114	160	
303	Phthalonamide (\$\beta\$ form)	155d		146			1	N	H <sub>3</sub>			
304	3-Nitroacetanilide	155		16 6	118 2	78	86 0		114	mono 155, di 76	mono 155, di 150	
305	Pimelic acid dianilide	155-6		104–5, subl	22315		di 136 6		184	114	160	
306	Pivalamide	155-7, 153-4		35 5	163-4		75-6	N	H <sub>8</sub>			
307	N-Phenylsuccinimide	156		185, 182 8	235d	di 88	di 211		184	114	160	
308	Dibromoacetamide	156		48	232-5			N	H <sub>3</sub>			
309	L-Malamide	156 5- 8 0		100-1		mono 87 2, di 124 5	di 179	N	H <sub>3</sub>			
310	Phenylacetamide	156, 157	196	76 5, subl	256 5 (cor)	65	89	N	H <sub>3</sub>			
311	3-Hydroxybenzanilide	157, 155		200, subl	, ,	106-8	176, 176 1 4		184	114	160	
312	Succinic acid monoamide (Succinamic acid)	157		185, 182 8	235d	di 88	dı 211	N	Н,			
313	N-A cetylindole	157-8		166	118 2	78	86	52	253	157-8	68	
	d l-Phenylsuccinamide (α form)	158		167-8					H <sub>3</sub>			
315	4-Benzotoluidide (N-Benzoyl-p-toluidine)	158		122 4	249	89	119	45	200	147	158	CrO <sub>3</sub> → 4- Benzamido benzoic acid, 278
316	N-(1-Napthyl) acetamide	159		16 6	118 2	78	86 0	50		159	160	Br <sub>2</sub> → 4-Bromo deriv, 193, Fuming HNO <sub>3</sub> →dinitro deriv, 250

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			<u> </u>		Derived	acıd	· · · · ·		Deriv	ed amine		
No	Name	Melting point °C	Xan thyl amide	MP,°C	ВР,°С	p-Nitro benzyl ester	p Bromo phenacyl ester	MP,°C	вР,℃	Acet amide	Benz- amide	Miscellaneous
317	4-Toluamide	159, 160	224-5	179-80, 182, subl	275 (сог)	104 5	153	ı	H <sub>3</sub>			Mercury deriv, 260
318	Crotonamide	161, 158		72, w	189 (cor)	67.4	95 6	1	≀ NH₃			
319	N-(1-Naphthyl) benzamide	161		122 4	249	89	119	50	1	159	160	
320	N-(2-Naphthyl) benzamide	162		122 4	249	89	119	112		132	162	
321	4-Aminoacetanilide	162		16 6	118 2		86 0	140, 147	267	mono 162 3, di 304	mono 128, di 300	Azo-β-naphthol deriv, 261
322	4-Hydroxybenzamide	162		215, 213		180-2	191 5	N	H <sub>3</sub>			
		(hyd)		4, 210		:	(cor) 184					
323	Benzanilide	163 160		122 4	249	89	119		184	114	160	Br <sub>2</sub> →4-Bromo deriv, 204
324	I-Naphthanilide	163, 164		161 2 (cor)		]	135 5		184	114	160	
325 326	Trichlorolactanilide Veratramide	164 164		124 181	1				184   H <sub>3</sub>	114	160	
327	2-Benzoylbenzamide	165		128, 91		100 4	ł		H <sub>3</sub>			
52.	2 - 51125, 15511-11115			(hyd)					i			
328	L-Glutamamide	165		(rapid htng), 197 (slow htng)				N	H <sub>3</sub>		!	
329	Protocatechuanilide	166		199- 200d			188		184	114	160	
330	4-Anisamide	167, 163		184 6 184 2 (cor)	275-80	132	152	N	Н <sub>3</sub>			Mercury deriv, 222
331	4-Bromoacetanılıde	167, 168		166	118 2	78	86 0	66	245	168	204	
332	Acetylanthramlamlide	167		185 ac					184	114	160	
				a	į				i			
333		168 168		148 122 4	249	89	119	19 23	H <sub>3</sub>	128	168	
334	$\alpha$ -Benzoyl- $\beta$ -phenylhydrazine 2-Furanacrylamide ( $\beta$ -(2-Furyl)-			141	286	07	119		H <sub>3</sub>	120	100	
333	aerylic acid)	700 )		471	200			[	i'' [			
336	Piperonylamide	169		229, 228					H <sub>3</sub>			
337	d l-Tropamide	169		117-8					H <sub>3</sub>			
338	Methyliminodiacetic acid	169		227d				N	H <sub>3</sub>			
339	monoamide Methyliminodiacetic acid	169		227d			and the state of t	N	  H <sub>3</sub> 			
340	diamide 4-Hydroxyacetanilide	169		16 6	118 2	78	86 0	184,		mono	N-	
								186		168, di 150	mono 216-7, N,O- di 234	
341	4-Anısanılıde	169-71		184 6 184 2	275-80	132	152		184	114	160	ı
342	3-Hydroxybenzamide	170 167		(cor) 200 subl		106 8	176 176 7-	N	Н <sub>3</sub>			
343	Sebacic acid monoamide	170		33, subl	24315	di 73 5 72 6	di 147	N	Н <sub>3</sub>			
344	cis-Aconitanilide	170d		125		120	tri 186		184	114	160	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

					Derived	acid		Γ΄	Deriv	ed amine		
No.	Name	Melting point, °C	Xan- thyl- amide	M.P., *C	B.P., *C	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	M.P.,°C	B.P., °C	Acet- amide	Benz- amide	Miscellaneous
345	Malonic acid diamide	170	270	134.89		di: 85.5		N	<del> </del> H₃			
346	(Malondiamide)  D,L-Phenylsuccinic acid  monoanilide (β form)	170		167-8; 84 (anh.)					184	114	160	
347	4-Ethoxybenzanilide	170; 172		198; 195-6					184	114	160.	
348	2-Naphthylanilide	171; 173		184; 185.5					184	114	160	
349 350	N,N'-Diacetylethylenediamine . Benzo-2,4,6-trichloroanilide (N-Benzoyl-2,4,6- trichloroaniline)	172 172		16.6 122.4	118.2 249	78 89	86.0 119	8.5 78	116	di: 172 148	di: 244 172	
351	Azelaic acid diamide	172		106.5	> 360 sl. d.; 23715	di: 43.8	di: 130.6	N	H <sub>3</sub>			
352	Maleic acid monoamide (Maleamic acid)	172–3; 153 sl.d.		137-8; 130 (+3% fumaric acid)		di: 91 (cor.)	168–70; 190	N	H <sub>3</sub>			
353	4-Phenetylurea (Dulcin)	173						2-3	248; 254	137	173	
354	<b>4-Benzophenetidide</b>	173		122.4	249	89	119	2-3	248; 254	137	173	.,
355	Benzylanilide	174-5		150		99.5	152		184	114	160	
İ	Pimelic acid diamide	175		104-5, subl.	22315		di: 136.6	N	Н,			
j	d,l-Phenylsuccinic acid monoanilide (α form) 4-Hydroxyphenylacetamide	175		167-8; 84 (anh.) 148-50;					184 H <sub>3</sub>	114	160	
]	Citraconic acid dianilide	175.5		148, w. 92-3;		70.6			184	114	160	
360	Glutaric acid diamide	175-6		22d. 98	302~4	di: 69	di: 139.8	N	H <sub>3</sub>			
361	2-(4-Toluyl) benzamide	175-6		139-140			[	N	H <sub>3</sub>		<i></i>	<i></i>
	2-Nitrobenzamide	176; 175		146		112	107		H <sub>3</sub>	,	[ . <i>.</i>	
	Phthalonic acid monoanilide	176		146		1			184	114	160	
	N,N-Dibenzoyltetra- methylenediamine	177		122.4	249	89	119	27	159	di: 137	di: 177	
365	Acetylanthranilamide	177		185, ac. a.				N	H <sub>3</sub>			
1	2,6-Dimethylacetanilide	177		16.6	118.2	78	86.0		215;	177	168	
ĺ	D-Camphoric acid monoamide .	177	- 1	187.5- 8.0	•••••	65.5		NI I		• • • • • • • • • • • • • • • • • • • •		
368	Mesaconic acid diamide	177		204.5 (cor.), subl.	•••••	di: 134 (cor.)		N	H <sub>3</sub>	••••		
	4-Cyanobenzanilide	179. 179		219; 214 200-6; 191 (sealed tube); 230 rapid htng.)		189 di: 155.5	di: 152.8		184 184–5	114 60	160 105	
372	4-Chloroacetanilide	179			118.2	78	86.0	72		179	192	
		179d.		146	110.2		00.0	,	Н <sub>3</sub>			
3,3	~	.,,	}	. 70				171	- 8			

<sup>\*</sup>Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Xan-		Deriveo	l acid			Deriv	ed amine	<b></b>	j
No	Name	Melting point, °C	thyl- amide	м Р, ℃	ВР,℃	p Nitro benzyl ester	p Bromo- phenacyl ester	мР,℃	вР,℃	Acet- amide	Benz- amide	Miscellaneous
374	2,4-Dimethylbenzamide	179 81		127, 90				N	Н 3			
25.5				(+H <sub>2</sub> O)								
	D-Tartaric acid monoanilide	180d		169 71		di 163	di 204		184	114	160	
376	α-Acetyl-β-methylurea	180		16 6	118 2	78	86 0	1	-6	28	80	
377 378	Diphenylacetanilide 3,5-Dinitrosalicylamide	180		148	}	ļ	1	١ .	184	114	160	}
379		181	İ	182 131, 135	}			3	H <sub>3</sub>			
	I-Naphthylacetamide Maleic acid diamide	181 181, 180		137, 135		di 91	168 70.	1	Н3			1
300	Majeic acid diamine	101, 100		137		(cor)	190	18	H <sub>3</sub>			
381	unsym-Dimethyl urea	182	225			(COI)	190		7		41	
382	Thiourea	182	1223			1			l ′ ∣H₃		• 1	
	Hippuramide	183		187		136	151	,	п <sub>3</sub> Н <sub>3</sub>			
	4-Tolylurea	183		107		130	1,21	ſ	200	147	158	
	3,5-Dinitrobenzamide	183		204-5		157	159	1	H <sub>3</sub>	147	136	
	2-lodobenzamide	184		162		111	143	1	H <sub>3</sub>			
	4-lodoacetanilide	184	l	166	118 2	78	86 0	67-8	П3	184	222	
	Benzo-4-fluoroanilide	185		122 4	249	89	119	-1	186	152	185	
300	(N-Benzoyl-p-fluoroaniline)	103		122 7	247	07	117	- 1	100	132	103	ŀ
380	N,N'-Diacetyl-o-phenylene-	185	ļ	16 6	118 2	78	86 0	102		di 185	dı 301	
307	diamine	10)		100	110 2	1'8	1000	102		ui 10)	<i>ui</i> 301	
390	2-Nitrocinnamamide	185		240		132	141	N	H <sub>3</sub>		ľ	
391	Mesaconic acid dianilide	185 7	]	204 5		di 134	171	1	184	114	160	
371	Mesaconic acid diaminde	1057		(cor )		(cor)		1	104	114	100	
392	Citraconic acid dramide	185-7		92-3.		di 70 6		N	l H₃			
372	Citi aconic acid dianinge	103-7		92-3, 92d		ui 100		"	П3			
393	Chlorofumaranilide	186		191-2		di 138 5			184	114	160	
394	3-lodobenzamide	186	1	187		121	128		H <sub>3</sub>	117	100	
Ti di	Suberic acid dianilide	186-7		144, 139-		di 85	di 144 2	1	184	114	160	
370	Suberic acid diaminge	180-7		41		ui 65	at 144 2		104	114	100	
306	Maleic acid dianilide	187		137		dı 91	168-70,		184	114	160	
3,0	Mareic acid diaminde	107		137		(cor)	190		104	117	100	
397	Maleic acid monoanilide	187		137		di 91	168-70,		184	114	160	1
371	Mareic acid inonoaninge	107		137		(cor)	190		104	114	100	
398	Hippuric acid	187 5		122 4	249	89	119	Gly-		206	187 5	Acetamide, 136,
3,0	Trippuric aciu	10, 3		122 4	247	"	1117	cine		200	10, 5	Benzamide, 151
							ŀ	228			i	benzamide, 151
			ļ				ļ	30,	į		ļ	
						1		262d				
399	unsym-Diphenylurea	189	180					53 4		101	180	
	Aconitic acid dianilide	189	1.00	194-5d		ì	tri 186		184	114	160	
		1		(сог)				ŀ				
401	meso-Tartaric acid diamide	189~90,	l	140		93	l	N	H,		[	
		187				ľ.			i.,			
402	4-Bromobenzamide	189-90	ł	251-3		180		N	I Н,		[	Mercury deriv,
	- Di olilosonaniae	1.07 70	<b> </b>			1.00	ŀ	i '`	i''		1	266
403	Itaconic acid dianilide	190, 185		165		di 90 6	di 1174		184	114	160	•••
	Picramide	190		122 5					H <sub>3</sub>	•••		Acetamide, 230,
	a lei amilee	1.70	1	1.22		1			i i			Benzamide, 196
405	N,N'-Diacetyl-m-phenylene-	191		16 6	118 2	78	86 0	63		mono	mono	20
	diamine	1.,,				"	" "	"		87-9,	125	
	armittes.									di 191	di 240	
406	Itaconic acid diamide	191 2-		165		di 90 6	di 1174	N	Н,	/1		
770		8	f			-		``i	-3		<b>\</b>	}
407	Mucic acid monoamide	192d		214d ,		310	225	N	Н,			
777				varies			1	``				
- 1		1		with							1	1
		1		htng								
- [		ľ	l	rate,		1					l	ļ
		I	1	223-			1				1	
ı												

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			Xan		Derive	d acıd				Deriv	ed amine		
No	Name	Melting point, °C	thyl amide	MP °C	BP °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P	·c	BP °C	Acet amide	Benz- amide	Miscellaneous
408	4-Nitrophthalamlide	192		165						184	114	160	
409	2-Tolylurea	192	228							200	110-11	146	
410	Benzo-4-chloroaniline	192	1	122 4	249	89	119		- 1	72	179, 172	192	١.
	(N Benzoyl p-chloroaniline)		Į.			ļ			- 1				
411	Biuret	192d				İ			N	Н,			
412	2-Naphthamide	192 195	1	184					N	Н,			
		İ		185 5	•	1					•		
	D-Camphoric acid diamide	193	ł	187 5 8 0	i	65 5			Ν	H <sub>3</sub>			
414	4-Chlorobenzanılıde	194	[	243, 240		129 5	126		- (	184	114	160	
415	4-Coumaramide	194		210 3 206					N	Нз	į		
416	2-Benzoylbenzanılıde	195		(anh )		100 4	[			104			
+10	2-Denzoyibenzaniide	193		128 91		100 4			Į	184	114	160	
		ĺ	ĺ	(+1	[		ĺ		ì				
417	3.8(	106		H₂O)		174	170 173		NI.	บ			
	3-Nitrocinnamamide	196	1	199 169 71		di 163	178, 173 di 204			H <sub>3</sub> H <sub>3</sub>			
	D-Tartaric acid diamide	196d				1		120	N	пз	202		
	2-Methyl-4-nitroacetanilide	196 202		16 6	118 2	78	86 0	130	1	184	202 114	160	
<b>+</b> 20	L-Malanilide (Hydroxysuccin anilide)	197		100 1	)	mono 87 2 di	di 179			104	114	160	
						124 5							
421	4-Hydroxybenzanilide	198		215		180 2	191 5			184	114	160	
	, ,	196 7		213 4	l		(cor)						
122	4-Nitrophenylacetamide	198		153			207		N	Н,			
	4-Nitrophenylacetanilide	198		153			207	147			215	di 193 , . 203	
424	Cyanoacetanilide	198-9	ĺ	66	1	(	Ì			184	114	160	
425	Citric acid trianilide	199 192 (+1 H <sub>2</sub> O)		100 153 (anh)		tri 102	tri 148			184	114	160	
436	4 N. a hab-tt-	200d		165		ł	1		N	H <sub>3</sub>			
	4-Nitrophthalamide	2000		125		1	tri 186			184	114	160	<u> </u>
127	cis-Aconitic acid dianilide	ł.		1115			177 100			184	114	160	
	Methylsuccinic acid diamilide	200	222	241		168	137		N	H <sub>3</sub>		100	
129	4-Nitrobenzamide	200	232	,	1	100	137			H <sub>3</sub>		}	
	2-Naphthylacetamide	200 205		141 2 143					13	113			
431	Isatın	200 1			l	1							Acetamide, 147
432	3-Nitrophthalic acid diamide	201d	l	218		189			N	Н,			
433		201		33, subl	243 15	di 73 5 72 6	di 147			184	114	160	
434 435	1-Naphthoamide 4-Ethoxybenzamide	202		(cor)			135 5			H <sub>3</sub>			
	,	202		198 195–6			<u> </u>		N	H <sub>3</sub>			
	2,4-Dinitrobenzamide	203		183	1	142	158		N	H <sub>3</sub>			
437	D-Camphoric acid	204	ĺ	187 5	ł	65 5	1			184	114	160	}
438	monoanilide Benzo-4-bromoanilide	204		8 0 122 4	249	89	119	66		245	168	204	
420	(N Benzoyl-p bromoaniline)	1201 212			!		l	Ì		l			
	4-Nitrocinnamamide	204, 217	1	285		186	191		N	H <sub>3</sub>			
440	N-Phenylphthalimide	205	!	200 6 191 (sealed		di 155 5	di 1528			184	114	160	
	1	1	1	tube),	1		]					Į	
		1		230			1						
				1									
	[	1		(rapid						1			1
	l	1	1	htng)	í	i	(	ľ		1	ł	ì	ı

<sup>\*</sup>Derivative data given in order in pi, crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			Xan		Derive	d acid			_	Deriv	ed amine		
No	Name	Melting point °C	thyl amide	MP °C	вр℃	p-Nitro benzyl ester	p-Bromo phenacyl ester	MP °	c i	BP ℃	Acet amide	Benz amide	Miscellaneous
441	Carballylic acid triamide	207d 205		166			tri 138 2	1	\ ИН 	3			
442	Gallanilide	7d 207		253 4d 222 40d		141	134		1	184	114	160	
443	Phthalonic acid diamilide	208		146					1	184	114	160	
444	Hippuranilide	208	ļ	187		136	151		•	184	114	160	
445	2-Coumaramide	209d		207 8, subl		152 5		1	۱ ۱	3			
446	Sebacic acid diamide	210 208		133, subl	24315	di 73 5 72 6	di 147	1	и 	3			
447	4-lodobenzanılıde	210		270, 265		141	146		1	184	114	160	
448	Citric acid triamide	210-5		153 (slow htng)		tri 102	tri 148	ı	NH	[ <sub>3</sub>			
449	4-Nitrobenzanilide	211 204		241		168	137			184	114	160	
450	d /-Phenylsuccinic acid	211		167 8 84				1	ŊΉ	[ <sub>3</sub>			
	diamide			(anh)				ĺ,					
451	Protocatechuamide	212		199 200d		188	1	,	NH 	13		1	
452	2,2'-Diphenic acid diamide	212		227 233		di 187 182 6		1	NH	$\mathbf{I}_3$			
453	4-Nitroacetanilide	213 4	•	16 6	118 2	78	86 0	147 8			215	di 199 20	3
454	Ethylmalonic acid diamide	214		111		75	}	ı	١Н				
	3-Nitrophthalimide	216		218		189			۱H	•			
456	Suberic acid diamide	216 7		144 139 41		dı 85	di 144 2	1	۱H	3			
457	Methylmalonic acid diamide	217 206		137 138d				1	۱ ۱	3			
	4-lodobenzamide	217		270 265		141	146	1	١H	-			
	Benzylmalonic acid dianilide	217		117d 121		di 1195			•	184	114	160	
	4-Hydroxy-2-naphthamide	217 8		225 6	1103	70	06.0		НΝ				
	Acetylurea 3-Hydroxy-2-naphthamide	218		16 6 222 3 (cor)	118 2	78	86 0		νН Н				
463	svm -Di-3-tolylurea	218		()		)			12	203	65	125	
464	Phthalic acid diamide	220		200-6, 191 (sealed tube) 230 (rapid htng)		dı 155 5	di 1528	1	NH	3			
465	Mucic acid diamide	220		214d, varies with hting rate, 223-255		310	225	1	H	l <sub>3</sub>			
466	Saccharin	220	198 9	206				1	ч'n	l <sub>3</sub>			
467	Adipic acid diamide	220, 229		153-4	21615	106	152 6	1	Ч	3			
468	d l-Phenylsuccinic acid dianilide	222		(cor) 167–8, 84 (anh)			154 5		1	184	114	160	

<sup>\*</sup>Derivative data given in order m p, crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

		<u> </u>	T.,		Derived	d acid			Deriv	ed amine		
No	Name	Melting point °C	Xan thyl amide	MP °C	BP °C	p Nitro benzyl ester	p Bromo phenacyl ester	MP °C	BP °C	Acet amide	Benz amide	Miscellaneous
469	β-Resorcylamide	222		213d (rapid htng) 216d 217		188 9		N	H <sub>3</sub>			
470	4-Cyanobenzamide	223		219 214		189		l N	H <sub>3</sub>			
471	Diethylmalonic acid diamide	224	ł	125	302 4	di 91	1		, Н <sub>з</sub>	{	i	i
	Glutaric acid diamilide	224		98		di 69	di 139 8	1	184	114	160	
	5-Nitrosalicylanilide	224		229 30			"		184	114	160	
	5-Nitrosalicylamide	225		229 30	1			N	H <sub>3</sub>			
	Benzylmalonic acid diamide	225		117d 121		di 1195		1	н <u>,</u> 			
476	Methylsuccinic acid diamide	225		115			İ	N	Н₃			
477	Malonic acid dianilide	225 227, 230		134 8- 9		di 85 5			184	114	160	
478	d l-Tartaric acid monoamide	226		203 4 (+1 H <sub>2</sub> O) 205 6 (anh)		di 147 6		N	H <sub>3</sub>			
479	D-Camphoric acid dianilide	226	1	187 5 8 0		65 5		ł	184	114	160	
480	Succinic acid dianilide	230, 226		185 182 8	235d	dı 88	dı 211		184	114	160	Heat above m p  → succinanil,  155 6 +
481	2,2 -Diphenanilide	230		227 229		di 187 182 6			184	114	160	anılıne, bp 184
482	Phthalimide	233 5 (cor) 238	176 7	233 200 6 191 (sealed tube) 230 (rapid htng)	249	89	119	122		232	198, 204	
483	3,5-Dinitrobenzanilide	234		204 5		157	159		184	114	160	
	3-Nitrophthalic acid dianilide	234	l	218		189	' '		184	114	160	
	Terephthalic acid monoanilide	234 7		300, subl with out melting		di 263 5	dı 225		184	114	160	
486	d l-Tartaric acid monoanilide	236		203 4 (+1 H <sub>2</sub> O) 205 6 (anh)		33.4 10.00 mg.			184	114	160	
487	N-Benzylacrylamide	237		13	141, 140	İ			184 5	60	105	
488		238, 240		_	,				184	114	160	
489	Muconic acid diamide	240d		289d (slow htng) 306 (rapid htng)				7	H <sub>a</sub>			
490	Adipic acid diamilide	241		153-4 (cor )	21615	106	152 6, 154 5		184	114	160	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			Xan-		Derive	d acıd			Deriv	ed amine		
No	Name	Melting point, °C	thyl amide	M P, °C	BP, °C	p-Nitro- benzyl ester	p-Bromo- phenacyl ester	МР,°С	BP,°C	Acet- amide	Benz- amide	Miscellaneous
491	N,N'-Dibenzoylethylene- diamine	244		122 4	249	89	119	8 5	116	dı 172	di 244	
492	Gallamide	245		253-4d , 222 40d		141	134	N	H <sub>3</sub>			
493	3-Hydroxy-2-naphthanilide	249 (cor), 244		222-3 (cor)	<u> </u> 				184	114	160	i
494	sym-Di-2-tolylurea	250		i		1			200	110 1	146	
495	Carballylic acid trianilide	252		166			<i>tri</i> 138 2		184	114	160	
496	Phthalic acid dianilide	253 5		200 6, 191		di 155 5	di 152 8		184	114	160	
497	Oxalic acid dianilide	254		(sealed tube), 230 (rapid hting) 189 5 (anh), 101 (+2 H <sub>2</sub> O)		dı 204			184	114	160	
498	Succinic acid diamide	255, 260d	275	(rapid htng ) 185, 182 8	235d	dı 88	dı 211	N	H <sub>3</sub>			
499	2,4,6-Trinitrobenzamıde	264d		228		1		N	Н <sub>3</sub>			
500	D-Tartaric acıd dianilide Fumaric acid diamide	264d 266d		169-71 293 5 286-7 (sealed tube), 200,		di 163 150 8	dı 204		184   H <sub>3</sub>	114	160	
503	Di A talalana	260	(	subi				45	200	147	158	,
	sym-Di-4-tolylurea Isophthalic acid monoamide	268 280		348, subl		202 5	179 1		200 H₃	147	1100	
	Isophthalic acid diamide	280		348, subl		202 5	179 1		H <sub>3</sub>		ł l	
	Acetylenedicarboxylic acid diamide	294d		179		202 3	1791		H <sub>3</sub>			
506	Mucic acid monoanilide	310		214, varies with htng rate, 223-255		310	225	,	184	114	160	
507	N,N'-Diacetyl <i>p</i> -phenylenedi- amine	310		166	118 2	78	86 0	140, 147	267	mono 162-3, di 304	mono 128, di 300	
508	Fumaric acid dianilide	314		286 7 (sealed tube), 293-5, 200, subl		1508			184	114	160	
509	N,N'-Diacetylbenzidine	317			118 2	78	86 0	127		mono 199, di 317	mono 203-5, di 352	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES b) Solids (Listed in order of increasing m.p.)\* (Continued)

			V		D	erived	acid			Deriv	ed amine		
No	Name	Melting point, *C	Xan- thyl amide	M P,*C	ВP	•c	p Nitro benzyl ester	p-Bromo- phenacyl ester	м ₽,*С	<b>B</b> P,*C	Acet- amide	Benz- amide	Miscellaneous
510	Terephthalic acid dianilide	334 7		300, subl without melting			dı 263 5	dı 225					
511	N,N'-Dibenzoylbenzidine	352		, -	249		89	119	127		mono 199 di 317	mono 203 5 di 352	
512	Trimesic acıd triamıde	365d		380 (cor )				tri 197 (sealed tube)	1	H <sub>3</sub>			
513	Oxalıc acid diamide	419d (sealed tube)		189 5 (anh ), 101 (+2 H <sub>2</sub> O), (rapid htng )			di 204		Z	H <sub>3</sub>			

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE XVI**

Hydrolysis to the corresponding acid and alcohol \*

RCOOR' + KOH 
$$\rightarrow$$
 R'OH + RCOOK
Alcohol  $\downarrow$  H<sup>+</sup>
RCOOH

From the ester with aqueous sodium or potassium hydroxide

For directions and examples see Cheronis, p 539, Linstead, p 42, Vogel, pp 390, 391, 786, Wild, p 187

From the ester and potassium hydroxide in anhydrous or aqueous diethylene glycol

See Cheronis, p 538, C E Redemann and H J Lucas, Ind Eng Chem, Anal Ed, 9, 514 (1937)

From the ester with sodium methoxide in methanol or with sodium ethoxide in ethanol

See Linstead, p 40, Vogel, p 391

From an  $\alpha$ -hydroxy ester in water without catalyst

See A Findlay and E M H Hickmans, J Chem Soc, 95, 1004 (1909)

#### Saponification equivalent

The saponification equivalent (S E) measures the number of equivalents of base required for complete hydrolysis of an ester. It is defined as

For directions and examples see Cheronis, pp 975 6, Shriner, p 235 Vogel, p 392

NOTE For directions and examples for preparation of derivatives of the carboxylic acids formed on hydrolysis of esters see explanations and references to Tables XII, XIII and XIV, pp. 186, 187, 188, 189

For directions and examples for preparation of derivatives of alcohols formed on hydrolysis of esters see explanations and references to Table VI, pp. 77, 78, 79

Amıde

$$RCOOR' + NH_3 \rightarrow RCONH_2 + R'OH$$

From the ester with aqueous or alcoholic ammonia

For directions and examples see Linstead, p 42, Wild, p 188

Anilide and p-Toluidide

$$X \longrightarrow NH_2 + C_2H_5MgBr \rightarrow X \longrightarrow NHMgBr + C_2H_6$$

$$Ansline (X = H)$$
or p-Toluidine (X = CH<sub>3</sub>)
$$2 \quad X \longrightarrow NHMgBr + RCOOR' \rightarrow RC(NH \longrightarrow X)_2OMgBr + R'OMgBr$$

$$RC(NH \longrightarrow X)_2OMgBr \longrightarrow RCONH \longrightarrow X + X \longrightarrow NH_3^+Cl^- + MgBrCONH \longrightarrow X + X$$

From the ester and the N-magnesium bromide derivative of aniline or p-toluidine (prepared from the amine and ethylmagnesium bromide) in anhydrous ether

Anilide (X=H)or p-Toluidide  $(X=CH_1)$ 

For directions and examples see Cheronis, p 537, Linstead, pp 42-3, Vogel, p 394, Wild, p 190, C F Koelsch and D Tenenbaum, J Amer Chem Soc, 55, 3049 (1933), D V N Hardy, J Chem Soc, 398 (1936)

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

#### **EXPLANATIONS AND REFERENCES TO TABLE XVI (Continued)**

Hydrazide

From the ester and 90% hydrazine hydrate
For directions and examples see Linstead, p. 42, Wild, p. 191

From the ester and 85% hydrazine hydrate in alcohol

See Cheronis, p 535, Shriner, p 237, Vogel, p 395, P P T Sah, Rec Trav chim, 59, 1036 (1940)

N-(β-Aminoethyl)morpholide \*

$$RCOOR' + H_2NCH_2CH_2N \xrightarrow{CH_2CH_2} O \rightarrow RCONHCH_2CH_2N \xrightarrow{CH_2CH_2} O$$

N ( $\beta$  Aminoethyl)morpholide

From the ester and N-(β-aminoethyl)morpholine in ethylene glycol or without solvent For directions and examples see Cheronis, p 536, R W Bost and L V Mullen, J Amer Chem Soc, 73, 1967 (1951)

#### 3,5-Dinitrobenzoate \*

RCOOR' + COOH 
$$\xrightarrow{H_2SO_4}$$
  $\xrightarrow{NO_2}$  COOR' + RCOOH

NO<sub>2</sub>  $\xrightarrow{NO_2}$   $\xrightarrow{NO_2$ 

From the ester with 3,5-dinitrobenzoic acid with a catalytic amount of sulfuric acid For directions and examples see Linstead, p 43, Shriner, p 238, Vogel, p 393, W B Renfrow and A

Chaney, J Amer Chem Soc, 68, 150 (1946)

From the ester with 3,5-dinitrobenzoyl chloride and pyridine
See Cheronis, p 538

<sup>\*</sup>Derivatives recommended for first trial

# Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.).\*

	···						5	aponifica	tion		Ţ			
No	Name	Boiling point	Melting point	n 20	D <sub>2</sub> o	Equiv	А	cıd	Alc	ohol	Amide	p Tolui	3 5 Di nitro-	Miscellaneous
		,c	°C			alent	MP, °C	BP,	M P °C	B P °C		dıde	benzoate	
1 2	Ethyl nitrite Methyl formate	17 31 50	-99	1 34648 <sup>15</sup> He (yel)	0 900‡5 0 97421	75 60	8 4	100 7	-117 3 -97	78 32 64 65	2 55	53	93, al 108 (cor ), al	
3	Ethyl formate Methyl acetate	54 15 57 1	79 4 98 7	1 35975 1 36170 1 3639	0 92247 0 9274 0 93347	74 74	8 4 16 6	100 7 118 2	-117 3 -97	78 32 64 65	2 55 82	53 153 147	93, al 108 (cor ), al	
5	Ethyl trifluoro- acetate	60 5		1 309315		142	-15 25	72 4	-1173	78 32			93, al	
6	Methyl nitrate	65			1 21715	77			-97	64 65			108 (cor ),	
7	Isopropyl formate	71,68			0 8728	88	8 4	100 7	-89 5	82 4	2 55	53	al 123, pet	
8	Butyl nitrite	75			0 911	103			-90 2	1176			eth 64,	
9	Methyl chloro- formate	75		1 38675	1 2231	94 5			-97	64 65			62 5 108 (cor ),	
10	Ethyl acetate	77 15	-83 6	1 372	0 90055	88	16 6	118 2	-1173	78 32	82	153 147	al 93, al	
11	Methyl propionate	79 65	-87 5	1 3779	0 9151	88	-20 8	141	-97	64 65	81 81 3, 79	j .	108 (cor),	
12	Methyl acrylate	80 3		1 3984	0 961 19 2	86	13	140, 141	-97	64 65	84-5, pet eth	141	al 108 (cor), al	Polymerizes on standing
13	n-Propyl formate	80 85, 81	-92 9	1 37789	0 9071, 0 918	88	8 4	100 7		97 1	2 55	53	74, pet eth	
14	tert-Butyl formate	83				102	8 4	100 7	25 5	82 5	2 55	53	142, pet eth	
15 16 17	Allyl formate Ethyl nitrate Isopropyl acetate	83 6 87 88 9, 91	-112 -73 4	1 374025	0 946 1 106 0 872	86 91 102	8 4 16 6	100 7 118 2	-117 3 -89 5	97 1 78 32 82 4	2 55 82	53 153, 147	49-50 93, al 123, pet	
18	Dimethyl carbon- ate (Methyl car- bonate)	90 5		1 3687	1 0702 1 0694	90			-97	64 65			eth 108 (cor),	
19	Methyl iso- butyrate	92 6, 92 26	-877, -847	1 3840	0 8906	102	-46 1	154 7	-97	64 65	128, 129	108 5- 9 5	108 (cor),	
20	Ethyl chloro- formate	93		1 3974	1 13519	108 5			-117 3	78 32			93, al	
21 22	sec-Butyl formate tert-Butyl acetate	97 97 8		1 384 1 386	0 884 0 867	102 116	8 4 16 6	100 7 118 2	25 5	99 5 82 5	2 55 82	53 153, 147	76 142, pet	
23	Isobutyl formate	98 4	-95 8	1 38568	0 88535, 0 8755	102	8 4	100 7		108 1	2 55	53	eth 87	
24 25	Isoamyl nitrite Ethyl difluoro- acetate	99 99		1 38708 <sup>21</sup> 1 3463	0 88015	117 124		134 5	-117 -117 3	132 78 32	52		61 93, al	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# Including esters of inorganic acids

			ĺ					Saponifica	tion		_			
No	Name	Boiling point,	Melting point,	n 20 D	D <sub>4</sub> <sup>20</sup>		A	cıd	Alco	ohol	Amide	<i>p</i> Tolui	3 5-Di- nitro	Miscellaneous
		·°C	·°C	υ	-,	Equiv- alent	MP,	BP, °C	M P °C	BP,		dide	benzoate	
26	Methyl meth- acrylate	99, 100 1	-50	1 413	0 936	100	16	161	-97	64 65	102 6		108 (cor) al	Polymerizes on standing or heating, 4-Bromo-
27	Ethyl propionate	99 1	-73 85	1 3853	0 8889	102	-20 8	141	-1173	78 32	81, 81 3, 79	126, 123	93, al	anilide, 116 N-(β-Amino- ethyl)mor- pholide, 85
28	Ethyl acrylate	101		1 4059194	0 913615	100	13	141	-117 3	78 32	84-5, pet eth	141	93, al	Polymerizes on standing or heating
29	Methyl pivalate (Methyl tri- methylacetate)	101		1 4228	0 8910	116	35 5	163-4	-97	64 65	155 7, 153 4, et ac - pet eth	119 20	108 (cor), al	or nouting
30	n-Propyl acetate	101 55	-95	1 38468	0 8834	102	16 6	118 2		97 1	82	153 147	74, pet	
31	Methyl <i>n</i> -butyrate	102 3	-84 8	1 3879	0 8982	102	-55 -8	162 5, 164	-97	64 65	115 6	75	108 (cor),	
32	Allyl acetate	104	,	1 40488	0 9276	100	16 6	118 2		97 1	82	153 147	49 50	
33	Trimethyl ortho- formate (Methyl orthoformate)	105, 102		1 3793	0 9676	106	8 4	100 7	-97	64 65	2 55	53	108 (cor), al	
34	Methyl iso- crotonate	106 2 108 2 (cor )				100	15	169	-97	64 65	101 2	132	108 (cor),	
35	n-Butyl formate	106 6	-919	1 38940	0 8885	102	8 4	100 7	-90 2	117 6, 116	2 55	53	64, 62 5	
36	Ethyl isobutyrate	109 8, 111	-88 2	1 3903	0 86930	116	-46 1	154 7	-1173	78 32	128, 129	108 5- 9 5	93, al	Hydrazide, 104, eth -al
37	n-Propyl nitrate	110		1 3979	1 063	105				97 1			74, pet eth	
38	Chloromethyl acetate	113			1 09415	108 5	166	118 2			82	153 147		
39	Isopropyl propi- onate	111 3			0 8931°	116	-20 8	141	-89 5	82 4	81, 81 3, 79		123, pet eth	
40	sec-Butyl acetate	1120		1 386525	0 872, 0 8648 <sup>25</sup>	116	16 6	118 2		99 5	82	153, 147	76	
41	n-Propyl chloro- formate	113 115		1 40350	1 0901	122 5				97 1			74, pet	
42		1167		1 390025	0 8808	116	- 30 0	176 5	-97	64 65	135, 137	106 7	eth 108 (cor ),	
43	Isobutyl acetate	117 2		1 39008	0 8747	116	16 6	1182		108 1	82	153, 147	al 87	
44	Ethyl pivalate (Ethyl trimethylacetate)	118 15		1 39061	0 85467	130	35 5	163-4	-1173	78 32	155 7, 153-4, et ac - pet eth	119 20	93, al	
45	Ethvi meth- acrylate	118 5***		1 41472	0 91063	114	16	161	-1173	78 32	102 6		93, al	Polymerizes on heating, 4-Bromo- anilide, 116

<sup>\*</sup>Derivative data given in order m.p. crystal color-solvent from which crystallized

# TABLE XVI. ORGANIC DERIVATIVES OF ESTERS Including esters of inorganic acids

		1						Saponificat	ion		_	1		}
No	Name	Boiling point,	Melting point,	n 200	D20	Equiv-	A	cıd	Alc	ohol	Amide	<i>p</i> - Tolus-	3 5-Di- nitro-	Miscellaneous
		·c	·c			alent	MP,	B ₽ , *C	MP, °C	<b>ВР</b> , °C		dide	benzoate	
46	Methyl crotonate	118 8- 119 3			0 98064	100	72	189 (cor)	-97	64 65	118, w , 115	132, bz	108 (cor),	
47	Isopropyl iso- butyrate	120 76			0 84708213	130	-46 1	154 7		82 4	128, 129	108 5- 9 5	123, pet eth	Hydrazide, 104, eth -al
48	Ethyl n-butyrate	121 6	- 100 8	1 40002	0 87917	116	-5 5, -8	162 5, 164	-1173	78 32	115-6	75	93, al	
49	n-Propyl pro- pionate	122 2, 123 4	-759	1 39325	0 8809	116	-208	141		97 1	81, 81 3, 79	126 123	74, pet eth	
50	tert-Amyl acetate (Dimethylethyl- carbinyl acetate)	124		1 392	0 873819	130	166	118 2	-8 55	102 3	82	153, 147	116,	
51		124				114	-20 8	141		97 1	81, 81 3, 79	126 123	49 50	<u></u>
52 53	Isoamyl formate Ethyl isocrotonate	124 2 125 5- 126 <sup>749</sup>	-93 5	1 39756 1 42423	0 8820 0 91820	116 114	8 4 15	100 7 169	-117 -117 3	132 78 32	2 55 101 2	53 132	61 93, al	
54	n-Butyl acetate	126 1	-73 5	1 39614	0 881	116	166	118 2	-90 2	1176,	82	153, 147	64, 62 5	
55	Diethyl carbonate (Ethyl carbon- ate)	126 5	-43 0	1 3852	0 9752	118			-1173	78 32		14/	93, al	
56	,	126 7		1 3921		144	-46 1	154 7	25 5	82 5	128, 129	108 5- 9 5	142, pet	Hydrazide, 104, eth -al
57	Methyl n-valerate (Methyl n- pentanoate	127 7	-910	1 397	0 885	116	-34 5	186 35	-97	64 65	106	74	eth 108 (cor),	
58		128			0 865213	130	-5 5, -8	162 5, 164	~89 5	82 4	115-6	75	al 123, pet	
59	Isobutyl chloro- formate	130, 128 8		1 4071117e9		136 5				108 1	ļ		eth 87	
60	Methyl methoxy- acetate	130		1 39636	1 0511	104		203	-97	64 65	96 5- 7 0, 92 4		108 (cor),	
61	Methyl chloro- acetate	130, 132		1 4221	1 238	108 5	α 61 3, β 56 2, γ 52 5	189	-97	64 65	121	162	108 (cor),	
62	Ethyl methoxy- acetate .	132			1 011815	118	γ 32 3	203	-1173	78 32	96 5 7 0,		93, al	!
63	n-Amyl formate	132 1, 130	-73 5	1 39916	0 8853	116	8 4	100 7	-78 5	138 (cor)	92-4 2 55	53	46 4	
64	sec-Amyl(3) acetate (Diethyl-carbinyl acetate)	133			1 4005	130	16 6	1182		1161	82	153, 147	101, 99, 97	
65		133 5		1 3960	0 869218	130	166	118 2		119 85	82	153, 147	62	
66	Allyl isobutyrate	134				128	-46 I	154 7		97 1	128, 129	108 5 9 5	49-50	Hydrazide, 104, eth -al
67 68	Ethyl isovalerate  n-Propyl iso- butyrate	134 7 135	-99 3	1 4009 1 3959	0 86565 0 8843°	130 130	-300 -461	176 5 154 7	-1173	78 32 97 1	135, 137 128, 129	106-7	93, al 74, pet eth	Hydrazide, 104, eth -al

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

# Including esters of inorganic acids

								Saponifica	tion					
No	Name	Boiling point,	Melting	n <sub>D</sub>	D?º		A	cıd	Alc	ohol	Amide	p- Tolui	3 5 Di	Miscellaneous
		·c	·c			Equiv	MP,	B P 'C	M P °C	B P ℃		dide	benzoate	
69	n-Butyl nitrate	136			1 048"	119			-90 2	117 6			64,	
70	Methyl pyruvate	136 8 138, 134-7			1 154°	102	13 6	165d	-97	64 65	124 5 145	109	108 (cor), al	2,4-Dinitro- phenylhyd- razone, 186 5 7 5 (cor ), yel , diox -me al
71	Methyl α-hy- droxyisobutyrate	137				118	79	212	-97	64 65		132 3, w	108 (cor),	
72	pionate	138, 137	-714	1 3975	0 88760	130	-208	141		108 1	81, 81 3, 79	123-6	87	
73	Ethyl crotonate	138, 136 7 <sup>749</sup>		1 42524	0 91752	114	72, w	189 (cor)	-1173	78 32	159 60, bz	132, bz	93, al	
74	Allyl <i>n-</i> butyrate	142				128	-5 5 -8	162 5, 164		97 1	115-6	75	49 50	
75	Isoamyl acetate (3-Methylbutyl acetate)	142		1 40034	0 8674	130	16 6	118 2	-117	132	82	153, 147	61	
76		142		1 393825	0 853817	144	- 30	176 5	-89 5	82 4	135 137	106 7	123, pet eth	
77	n-Propyl n-buty- rate	143 8	-95 2	1 4005	0 872	130	-55 -8	162 5 164		97 1	115 6	75	74, pet eth	
78	β-Methoxyethyl acetate (Ethylene glycol mono- methyl ether acetate, Methyl cellosolve acetate)	144			1 088	118	16 6	1182		124 5	82	153 147	4444	
79	Methyl bromo- acetate	144d			1 657	153	50	208	_ <del>9</del> 7	64 65	91		108 (cor),	
80	n-Butyl chloro- formate	145, 139		1 417* 1	1 079	136 5			-90 2	117 6, 116			64, 62 5	
81	$\beta$ -Chloroethyl acetate	145		1 4234	1 178	122 5	16 6	118 2		131	82	153, 147		
82	Methyl d  - lactate	145 144 8		1 4144	1 0931	104	16 8, 18	12215	_ <del>9</del> 7	64 65	78 5-9 0 (cor ), bz -al (3 1)	107	108 (cor), al	
83	Ethyl chloro- acetate	145	-26	1 42274	1 158	122 5	α 61 3, β 56 2, γ 52 5		-1173	78 32	121	162	93, al	
84	tert-Butyl n- butyrate	145-6 6		1 4001 17 5		144	γ 52 5 -5 5, -8	162 5, 164	25 5	82 5	115-6	75	142, pet eth	
85	Triethyl ortho- formate (Ethyl- orthoformate)	145 5		1 3922	0 8909	148	8 4	100 7	-1173	78 32	2 55	53	93, al	
86	Ethyl n-valerate (Ethyl n- pentanoate)	145 5	-912	1 40094	0 8739	130	-34 5	186 35	-1173	78 32	106	74	93, al	
87		146			1 087	136 5		186	-1173	78 32	80	124	93, al	Phenylhydra- zide, 95

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

								Баропібіса	ition					
No	Name	Boiling point	Melting	n &	D{"		А	cıd	Alc	ohol	Amide	p- Tolus-	3 5 Di nitro	Miscellaneous
		°C	·c	"0		Equiv- alent	M P °C	B P °C	M P °C	B P °C		dide	benzoate	
88	n-Butyl propionate	146 8	89 6	1 403815	1 401	130	-20 8	141	-90 2	117 6,	81 81 3. 79	126, 123	64 62 5	
89	Benzyl chloro- acetate	147		1 524618	1 2223+	170 5	α 61 3, β 56 2	189	-153	205 5	121	162	113	
90	bonate (Isopropyl	147 2 (cor)		1 3932	0 9162	146	γ 52 5		-89 5	82 4			123, pet	
91	carbonate) Methyl isobutyl- carbinyl acetate	148			0 8805"	130	16 6	118 2	-97	64 65	82	153 147	eth 108 (cor ),	
92	Methyl ethoxy- acetate	148			1 01121	118		206 7	-97	64 65	80 2	32, eth	al 108 (cor), al	
93	Isobutyl iso- butyrate	148 6	-80 65	1 3999	0 874960	144	-46 1	154 7		108 1	128, 129	108 5 9 5	87	Hydrazide, 104, eth -al
94	n-Amyl acetate (n-Pentyl acetate)	149 25	70 8	1 4031	0 8756	130	16 6	118 2	-78 5	138 (cor)	82	153 147	46 4	
95		150				132	79	212	-1173	78 32		132 3,	93, al	
96		151 2		:	1 16771 <sup>18</sup>	90	78 9 80		-97	64 65	120 al - et ac	143, w	108 (cor ), al	
97	Methyl n-caproate (Methyl n- hexanoate)	151 25	-710	1 405	0 88464	130	-39	205 35	-97	64 65	100 1	74 5	123, pet eth	
98	Isopropyl n- valerate (Iso- propyl n-	153 5		1 4009	0 8579	144	- 34 5	186 35	-89 5	82 4	106	74	61	
99	pentanoate) Isoamyl chloro- formate	154		1 41916 He	1 03215	150 5			-117	132			93, al	
100	Ethyl d,l-lactate	154 5		1 410	1 030	118	16 8, 18	12215	-117 3	78 32	78 5 9 0 (cor ), bz -al , (3 1)	107	93, al	
101	Ethyl pyruvate	155		0 059615 6	1 408 <sup>15 6</sup>	116	13 6	165d	-1173	78 32	124 5, 145	109, 130	93, al	Phenylhydrazone, 118, dil al 4-Nitro-phenylhydrazone, 185-7, 2 4-Dinitro-phenylhydrazone, 154 5 155 (cor ),
102	n-Propyl iso- valerate	155 5		1 4041317 8	0 864317 8	144	-30	176 5		97 1	135, 137	106-7	74, pet	diox -al
103	1	155 51	-62 65	1 40898 <sup>15</sup> He (yel)	0 88133	130	8 4	100 7	-51 6 -46 1	157 5	2 55	53	58 4 (cor)	

 $<sup>^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

						L	S	aponificat	ion					
No	Name	Boiling point,	Melting point	n 20	D <sub>2</sub> 0		Ac	ıd	Alco	hol	Amide	<i>p</i> ∼ Tolu₁-	3 5-Di nitro	Miscellaneous
		*C	°C		•	Equiv- alent	M P °C	B P °C	M P °C	B P °C	·	dide	benzoate	
104	β-Ethoxyethyl acetate (Ethylene glycol mono- ethyl ether acetate, Ethyl cellosolve acetate)	156 2, 158		1 40292	0 9701	132	16 6	118 2		135	82	153, 147	75, al	
105	, , , , , , , , , , , , , , , , , , ,	157		1 40295184	0 8620	144	-5 5 -8	162 5 164		108 1	115 6	75	87	
106	•	158		1 43860	1 2821	157	5 6	194	-1173	78 32	98	153	93, al	
107	acetate Ethyl bromo- acetate	159		1 451	1 506	167	50	208	-1173	78 32	(subl ) 91		93, al	
108	Ethyl glycolate	160			1 086915	104	78 9 80		-1173	78 32	120, al - et ac	143, w	93, al	
109	Isoamyl pro- pionate	160 2		1 4065	0 870	144	- 20 8	141	-117	132	81 81 3 79	126 123	61	
110	Ethyl $\alpha$ -bromopropionate	162			1 524	181	25 7	203 5	-1173	78 32	123	125	93, al	
111	Cyclohexyl formate	162 5750		1 443	1 010	128	8 4	100 7	25 1	161 1	2 55	53	112-3, al	
112	$\beta$ -Bromoethyl acetate	163			1 524	167	16 6	118 2		149d	82	153, 147		
113		165 5, 168 5		1 38619	0 93975	52			-117 3	78 32		147	93, al	Gives SiO <sub>2</sub> on hydrol-
114	n-Propyl n- valerate (n- Propyl n pentanoate)	166 2, 167	-70 7	1 4065	0 8699	144	-34 5	186 35		97 1	106	74	74, pet eth	ysis
115	n-Butyl n-butyrate	166 6	-91 5	1 406	0 869	144	-55	162 5,	-90 2	117 6 116	115 6	75	64, 62 5	
116	Ethyl n-caproate (Ethyl n hexanoate)	167 7	-67 5	1 40727	0 8710	144	-8 -39	164 205 35	-1173	78 32	100 1	74 5	93, al	
117		168		1 450	1 380	191 5	57 8	197 5	-1173	78 32	141	113	93, al	Phenylhyd razide, 123
118	Isopropyl <i>d,l-</i> lactate	168, 166-8		1 408225	0 998	132	16 8, 18	12215	-89 5	82 4	78 5 9 0 (cor), bz-al (3 1)	107	123, pet eth	
119	Di-n-propyl car- bonate (n-Propyl carbonate)	168 5 (cor)		1 4014	0 9411	146				97 1			74, pet eth	
120	n-Amyl propionate (n-Pentyl	168 7	-73 1	1 409615	0 8761 15	144	-20 8	141	-78 5	138 (cor)	81, 81 3, 79	126, 123	46 4	
121	propionate) Ethylidene di- acetate	169			1 06112	73	16 6	118 2	-126	197 85	82	153, 147	169	
122	Isoamyl iso- butyrate	169			0 8760°	158	-46 1	154 7	-117	132	128, 129	I .	61	Hydrazide, 104, eth -al
123	Methyl aceto- acetate	170		1 41964	1 0765°	116			-97	64 65			108 (cor),	Semicarba- zone, 152 5,
124	Isobutyl iso- valerate	171		1 40569	0 8534	158	- 30	176 5		108 1	135, 137	106 7	al 87	me al

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

						L	S	aponificat	ion					
No	Name	Boiling point,	Melting point,	n20	D20		Ac	nd	Alco	ohol	Amide	<i>p</i> - Tolui-	3,5-Dı- nıtro-	Miscellaneous
		°C	··c	, ,		Equiv- alent	MP, °C	ВР, °C	M P °C	BP, °C		dide	benzoate	
125	Methyl enanthate (Methyl n- heptanoate)	173 8	-55 8	1 412	0 88011	144	_7 <b>4</b> 7	223	-97	64 65	96, 96 5	81	108 (cor),	
126	Ethylene glycol diformate	174			1 1930	59	8 4	100 7	-78 5	138 (cor)	2 55	53	46 4	
127	sec-Butyl n- valerate (sec- Butyl n- pentanoate)	174 5		1 4081	0 860520	158	- 34 5	108 35		99 5	106	74	76	
128	Cyclohexyl ace- tate	175		1 442	0 970	142	166	1182	25 1	161 1	82	153, 147	112 3,	
129	n-Butyl chloro- acetate	175			1 081	150 5	α 61 3, β 56 2, γ 52 5	189	-90 2	117 6, 116	121	162	64, 62 5	
130	Furfuryl acetate	175 7		1 4627	1 118	140	166	118 2		172, 170	82	153, 147	80 1	
131	Methyl methyl- acetoacetate	177 4		1 418	1 030	130			- 97	64 65			108 (cor),	Semicarba- zone, 138, al
132	n-Heptyl formate	178 12		1 4150515 He (yel)	0 87841	144	8 4	100 7	-34 6, -33 8	176 8	2 55	53	46 47	
133	n-Hexyl acetate	178 1	-80 9, -60 9	1 41122 <sup>15</sup> He (yel)	0 87336	144	16 6	118 2	-51 6, -46 1	157 5	82	153, 147	58 4 (cor)	
134	lsoamyl <i>n-</i> butyrate	178 6		1 411	0 864	158	-5 5, -8	162 5, 164	-117	132	115 6	75	61	
135		179			1 425	181	62 5		-117 3	78 32	111		93, ai	2-Naphthyl- amide, 174
136	Ethyl acetyl- glycolate	179			1 099317	73			-117 3	78 32	4.		93, al	Hydrolysis  → glycolic  a + ac a +  al
137	Isobutyl n-valerate (Isobutyl n- pentanoate)	179		1 4099	0 8625	158	-34 5	186 35		108 1	106	74	87	ai
138	β-Hydroxyethyl formate (Ethylene glycol mono-	180			1 198915	90	8 4	100 7	-78 5	138 (cor)	2 55	53	46 4	
139	formate) Ethyl methylaceto- acetate	180 8 (cor ), 187		1 419	1 0191	144			117 3	78 32	73, eth		93, al	Anilide, 138– 40, Semi- carbazone, 194, 2,4-Di- nitrophenyl hydrazone,
140	Ethyl acetoacetate	181		1 41976	1 025	130			-1173	78 32			93, al	56-7 Semicarba- zone, 129, 133, eth
141	Methyl pyro- mucate (Methyl 2-furoate)	181 3		1 4860	1 180	126	133 4, 132	230-2	-97	64 65	142-3	170 5, al	108 (cor), al	2,4-Dinitro-

<sup>\*</sup>Derivative data given in order  $\, m \, p$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

		-					s	aponificat	ion					
No	Name	Boiling point,	Melting point	n 20	D!º	_	Ac	ıd	Aice	hol	Amide	<i>p</i> − Toluı	3 5 Di nitro	Miscellaneous
		·°C	·.c	ъ	_,	Equiv alent	M P °C	B P °C	M P °C	B P °C		dide	benzoate	
142	Dimethyl malo- nate (Methyl malonate)	181 5	-62	1 41398	1 1539	66	1348 9		<b>-97</b>	64 65	mono 106 110 di: 170 w -al	mono 156d di 252 3, al	108 (cor) al	Phenylhyd- razide, 194
143	Ethyl β-methoxy- ethyl carbonate	182 6		1 403625	1 042425	148			-1173	78 32	W -ai	3, 41	93 al	
144	Methyl cyclo- hexanecarboxy- late (Methyl hexahydro-	183		1 4537215	0 995415	142	30 1	233	-97	64 65	185 6		108 (cor), al	
145	benzoate) Diethyl oxalate (Ethyl oxalate)	185 19	-41 5, -40 6	1 41043	1 0785	73	189 5 (anh) 101 (+ 2H <sub>2</sub> O)		-1173	78 32	mono 219 di 419d	mono 169 di 268	93, al	N-(β-Amino- ethyl)- morpho hde 170
146	n-Amyl n-butyrate (n-Pentyl n- butyrate)	186 4	-72 3	1 412	0 866	158	-5 5, -8	162 5 164	-78 5	138 (cor)	115-6	75	46 4	
147	n-Butyl n-valerate (n-Butyl n- pentanoate)	186 9	-92 8	1 4123	0 8678	158	- 34 5	186 35	- 90 2	117 6 116	106	74	64 62 5	
148	β-Hydroxyethyl acetate (Ethylene glycol mono- acetate)	187-9				104	166	118 2	-78 5	138 (cor)	82	153 147	46 4	
149	n-Propyl n- caproate (n- Propyl n- hexanoate)	187 15 186	-74 0	1 417	0 86719	158	-39	205 35		97 1	100 1	74 5	74, pet eth	
150	Dimethyl sulfate (Methyl sulfate)	188	-27	1 3874	1 334815	63			-97	64 65			108 (cor),	
151	n-Butyl lactate	188	-43	1 4216	0 98420	146	16 8, 18	12215	-90 2	117 6 116	78 5-9 0 (cor ), bz -al (3 1)	107	64 62 5	
152	Ethyl enanthate (Ethyl n-hep- tanoate)	188 6	-66 3	1 413	0 86856	158	-7 <b>4</b> 7	223	-1173	78 32	96, 96 5	81	93, al	
153		189 7 (cor)			0 989	144			-97	64 65	95 6, bz		108 (cor),	
154	Di-isobutyl car- bonate (Isobutyl carbonate)	189 8 (cor)		1 4072	0 9138	174				108 1			87	
155	n-Hexyl pro- pionate	190	-57 5	1 41621 15 He (yel)	0 86980	158	-20 8	141	-51 6 -46 1	157 5	81, 81 3, 79	126 123	58 4 (cor)	
156	Ethylene glycol diacetate	190 2	-31	1 4150	1 1040	73	16 6	118 2	- 78 5	138 (cor)	82	153, 147	46 4	
157	Isoamyl iso- valerate	190 4		1 41300187	0 870	172	- 30	176 5	-117	132	135, 137		61	
158	n-Heptyl acetate	192 45		l 41653 <sup>15</sup> He (yel)	0 8707015	158	16 6	118 2	-34 6, -33 8	176 8	82	153, 147	46, 47	
159	Cyclohexyl pro- pionate	193750			0 97180	156	-20 8	141	25 1	161 1	81, 81 3, 79	126, 123	112 3, al	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

			_				S	aponificat	tion					
No	Name	Boiling point,	Melting point,	n <sup>20</sup>	D20	Equiv	Ac	ad	Alco	ohol	Amide	<i>p</i> - Tolu₁-	3 5 Di nitro	Miscellaneous
		°C	·c			alent	M.P., °C	BP,	M.P. °C	B P °C		dide	benzoate	
160	Di-isopropyl oxalate (Iso- propyl oxalate)	193 4		1 4100	1 0097	87	189 5 (anh ), 101 (+ 2H <sub>2</sub> O)		-89 5	82 4	mono 219, di 419d	mono 169, di 268	123, pet eth	
161	Ethyl $\beta$ -ethoxy- ethyl carbonate	194 5		1 506425	1 011525	162			-1173	78 32			93, al	
162	sec-Octyl acetate	194 5		1 4141	0 860619	172	16 6	118 2		179	82	153, 147	32	
163	Methyl n-capryl- ate (Methyl n- octanoate)	194 6	-41	1 417	0 878	158	16 3	237 239 3	<b>–97</b>	64 65	57	70	108 (cor), al	
164	α-Tetrahydro-	195, 194		1 4350	1 062425	144	16 6	118 2		177- 8 <sup>743</sup>	82	153, 147	83-4	
165	furfuryl acetate Methyl levulinate	196, 191		1 42333	1 04945	130	33 5	245-6	<b>-97</b>	64 65	107-8, al	108 9, w	108 (cor), al	Semicarba- zone, 142- 3, Phenyl- hydrazone, 94-6, 2,4- Dinitro- phenylhyd- razone, 141 5-2 5 (cor ), diox -al ,
166	Ethyl cyclo- hexanecar- boxylate (Ethyl hexahydroben- zoate)	196		1 4501215	0 967215	156	30 1	233	-1173	78 32	185 6		93, al	Oxime, 96
167	Diethyl methyl- malonate	196			1 01915	87	137, 138d	<u> </u>	-1173	78 32	217, 206	mono 145d , di 228, 214	93, al	
168	Phenyl acetate	196 7		1 503	1 078	136	16 6	118 2	41 8, 42	182	82	153, 147	145 8 (cor ), al	
169	Ethyl ethylaceto- acetate	198		1 422	0 9856	158			-1173	78 32	95 6, bz		93, al	Ketone cleavage → 2-penta- none, b p 102
170	n-Octyl formate	198 8	-39 1	1 4208215 He (yel)	0 87435	158	8 4	100 7	-16, -167	195	2 55	53	61-2	
171	2-Ethyl-1-hexyl acetate	199			0 873320	172	16 6	118 2		184 6	82	153, 147		
172	Methyl benzoate	199 2	-124	1 5164	1 0888	136	122 4	249	-97	64 65	130	158	108 (cor), al	
173	Diethyl malonate (Ethyl malonate)	199 3	-515	1 41618	1 05513	80	134 8 9		-1173	78 32	mono 106 10, di 170, w -al	mono 156d , di 252-3, al	ı	Phenylhy- drazide, 194
174	Methyl cyano- acetate	200	-22 5		1 096225	99	66		-97	64 65	119 20		108 (cor ), al	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### Including esters of inorganic acids

		Boiling	Melting			L		Saponifica	T		4	_	3,5 Dı-	
No	Name	point,	point,	n 20 D	D20	Equiv	A	void	Alc	ohol	Amide	<i>p</i> - Tolus-	nıtro	Miscellaneous
		,c				alent	M P, °C	B P °C	M P °C	BP, °C		dide	benzoate	
175	Dimethyl mesaconate	203		1 45119	1 0914	79	204 5 (cor)		-97	64 65	mono (α) 222 (β) 174, di	mono (α) 196, di 212, al	108 (cor), al	Dihydrazide. 215d , dil al
г76 177	1 *	203 203		1 516	1 080	136 148	8 4 122 4	100 7 249	-15 3	205 5	176 5 2 55 130	53	113	
178	Vinyl benzoate Cyclohexyl iso- butyrate	204750		-	0 9489°	170	-46 l	154 7	25 1	161 1	128 129		112-3, al	Hydrazide, 104, al -eth
179		204 4	76	1 44156	1 1451315	72	137		-97	64 65	mono 172 3, w, 153, sl d, di 181, me al	di,	108 (cor), al	
180	furfuryl pro-	204-7	}		1 044	158	-208	141		177 8 <sup>743</sup>	81, 81 3	126 123	83 4	-
181	pionate Ethyl levulinate	205 8		1 42288	1 01114	144	33 5	245-6	-117 3	78 32	107-8d	108-9, w	93, al	Semicarba- zone, 147 8 Phenylhyd- razone, 103-4, 2,4-Dinitro phenylhyd- razone, 101 2, diox -al, Oxime, 96
182	Ethyl allylaceto- acetate	206 sld, 211-2 sld		1 4317 6	0 9898	170			-117 3	78 32			93, al	Semicarba- zone, 125, w
183	n-Amyl n-valerate (n-Pentyl n- pentanoate)	207 4		1 418115	0 8825°	172	-34 5	186 35	-78 5	138 (cor)	106	74	46 4	
184		207 5 (cor)		1 4117	0 9238	174			-90 2	117 6, 116			64, 62 5	
185	n-Butyl n- caproate (n-Butyl n-hexanoate)	207 74	-63 1, -64 3	1 41877 <sup>15</sup> He (yel)	0 86530	172	-39	205 35	-90 2	117 6, 116	100-1	74 5	64, 62 5	
186	n-Hexyl n- butyrate	207 88	-78	1 41875 <sup>15</sup> He (yel)	0 86519	172	-55, -8	162 5, 164	-51 6, -46 1	157 5	115-6	75	58 4 (cor)	
187	2-Tolyl acetate ("o-Cresyl acetate")	208			1 048	150	166	118 2	31		82	153, 147	134 8 (cor), al	
188	Diethyl sulfate (Ethyl sulfate) n-Propyl n-enan-	208 208		1 4010 <sup>18</sup> 1 41835 <sup>15</sup>	1 172 <sup>25</sup> 0 86556	77 172	<b>-7 47</b>	223	-1173	78 32 97 1	96, 96 5	81	93, al. 74, pet	
190	thate (n-Propyl n-heptanoate) Ethyl n-caprylate	208 35		1 41775	0 8667		16 3	237,	-1173		110, 106		eth 93, al	N-(β-Amino-
	(Ethyl n-octanoate)		-43 1, β -59 2					239 3			,	. 9	. 5, 41	ethyl) mor- pholide, 59

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

ĺ			]		1	l _	S	aponificat	ion	_	]	]	]	
No	Name	Boiling point, °C	Melting point,	n 20	D20	Equiv-	A	ad	Alco	ohol	Amide	p- Tolui	3,5-Di- nitro-	Miscellaneous
		*c	·c			alent	M.P., °C	BP, ℃	M P °C	B P °C		dide	benzoate	
191	Isobutyl enanthate (Isobutyl n- heptanoate)	209			0 8593	186	-747	223		108 1	96, 96 5	81	87	
192		209 3		1 42088	0 98724	158	33 5	245 6		82 4	107 8d	108-9, w	123, pet eth	Semicarba- zone, 141-2, Phenylhyd- razone, 108 9, 2,4-Dinitro- phenylhyd- razone, 88-9 (cor ), 90 9
193	Trimethylene glycol diacetate (1,3-Diacetoxy- propane)	210	i i		1 069	80	16 6	118 2	- 30	214 7 210 2	82	153 147	178	
194	•	210			0 8847°	172	16 6	118 2	-16 -167	195	82	153 147	61 2	i
195	pionate	210	-50 9	1 42605 <sup>15</sup> He (yel)	0 86786	172	-20 8	141	-34 6 -33 8	176 8	81 81 3 79	126 123	46 47	<b>.</b>
196	Dimethyl citra- conate	210 5	· ·	1 44856	1 11531	79	92 91d eth lgr	206 11, sl d	<b>-97</b>	64 65	100 1		108 (cor), al	Dihydrazide, 177, w , 1- Naphthyl- amide, 169- 70
197	n-Propyl pyro- mucate (n-Propyl 2-furoate)	211		1 473725 9	1 074525 9	154	133-4,	230 2		97 1	142 3	170 5, al	74, pet eth	, ,
198		211			1 0544}	87	- 20 8	141	-78 5	138 (cor)	81, 81 3, 79	126 123	46 4	
199		212750			0 9572°	170	-5 5, -8	162 5, 164	25 1	161 1	115 6	75	112-3, al	
'00	3-Tolyl acetate ("m-Cresyl acetate")	212	12	1 4978	1 049	150	16 6	118 2	11 95	202 7	82	153, 147	164 5 (cor), al	
01	Ethyl aceto- pyruvate	213 5		1 475717	1 1251	158	101, bz		-1173	78 32	131 2d, al		93, al	
02	Ethyl benzoate	212 4 213 2	-347	1 50570	1 04684	150	122 4	249	-1173	78 32	130	158	93, al	N-(β-Amino- ethyl) mor- pholide, 123 4
203	4-Tolyl acetate ("p-Cresyl acetate")	212 5		1 500	1 051	150	16 6	1182	36	202	82	153 147	188 6 (cor), al	
204		213 9	-51 7	1 4168	1 0169	87	189 5 (anh), 101 (+2 H <sub>2</sub> O)			97 1	mono 219, di 419d	mono 169, di 268		NH₄OH → D₁-n-propyl oxamate, 90-2, me al
205	Methyl pel- argonate	214, 213-4			0 892	172	12 3	254 4	-97	64 65	99	84	108 (cor), al	
206	Dimethyl glu- tarate	214 <sup>751</sup>	-34 7	1 42415	1 0874	80	98	302 4	-97	64 65	dı 175	dı 218	108 (cor ), al	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# Including esters of inorganic acids

							S	aponifica	tion					
No	Name	Boiling point,	Melting point,	π <sup>20</sup>	D20	Equiv	A	eid	Alc	ohol	Amide	<i>p</i> − Toluı-	3,5-D1- nitro-	Miscellaneous
		*c	·c			alent	MP,	BP, ℃	MP,	BP,		dide	benzoate	
207	2,6-Dimethyl- phenyl acetate (vic-m-Xylenyl acetate)	214-6				164	166	118 2	49	203	82	153, 147	158 8 (cor), al	
208	,	215			1 068	150	104-5, 107 8	259751	-97	64 65	142 8 (cor)	144	108 (cor), al	
209	·	217		1 5200	1 055	150	16 6	118 2	-15 3	205 5	82	153, 147	113	N-(β-Amino- ethyl) mor- pholide, 95 2
210	Diethyl succinate	217 25	-20 8	1 41975	1 0398	87	185 182 8	235d	-1173	78 32	mono 157, di 260d, w	mono 179 80, di: 254 5- 5 5, 260	1	N-(\$\beta\$-Amino- ethyl) mor- pholide, 174
211	Diethylene glycol monoethyl ether acetate	218			1 013	176	16 6	118 2		198	82	153, 147	oil	
212	Diethyl fumarate	218 4, 213-4	0 55	1 44103	1 052	86	286 7 (sealed tube), 233-5, 200, subl		-1173	78 32	mono 270, 300-2, subl, di 266d	mono 233 0- 4 5, dt 313 4 ac a	93, al	
213	Isopropył ben- zoate	218 5		1 489025	1 013	164	122 4	249	-89 5	82 4	130	158	123, pet eth	
214	Methyl phenyl- acetate	220		1 507	1 068	150	76 5, subl	256 5 (cor)	_ <b>97</b>	64 65	156	135-6	108 (cor),	
215	/-Linalyl acetate	220		1 4460	0 8951	196	166	118 2		199	82	153, 147	a.	$[\alpha]_D$ -3 to -17, 4-Ni- troben- zoate, 70
216	Methyl 3-toluate (Methyl 3- methylbenzoate)	221, 215			1 061	150	111 3, 110-1	263, subl	-97	64 65	94, 97	118	108 (cor ), al	
217	n-Propyl levulinate	221 2		1 42576	0 98955	158	33-5	245 6		97 1	107-8d	108-9, w		Semicarba- zone, 129- 30, Hydra- zone, 88-90, Phenylhyd- razone, 67-8 (cor ), al ,
218	Diethyl d,l- tartronate	222-5d			1 15215	88	156-8d		-1173	78 32	<i>dı</i> 198, dıl al, 195– 6d		93, al	Oxime, 96

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### Including esters of inorganic acids

_		Γ	Γ	<u> </u>	Γ			aponificat	ion					
No	Name	Boiling point	Melting point	n <sup>20</sup>	D20		A	eid	Alce	ohol	Amide	<i>p</i> Tolui	3 5-Di nitro	Miscellaneous
		°C	°C	D		Equiv alent	M P	B P °C	M P °C	B P °C		dide	benzoate	
219	Diethyl maleate	222 7	<u> </u>	1 44156	1 066	86	137		-117 3	78 32	mono 172 3, w 152 3 sl d di 181, me al	di 142, eth	93, al	
220	Methyl salicylate	224		1 5369	1 184	152	158 3		-97	64 65	142, 139	156	108 (cor), al	
221	Ethyl <i>n-</i> butoxy- ethyl carbonate	224		1 41432	0 975625	190	 		-1173	78 32			93, al	
222	linate	225 8		1 42495	0 96698	172	33 5	245 6		99 5	107 8d	108 9, w	76	Oxime, 96
223	n-Heptyl n- butyrate	225 87	- 57 5	1 42279 <sup>15</sup> He (yel)	0 86371	186	-55 -8	162 5, 164	34 6 -33 8	176 8	115 6	75	46 47	
224	2,4-Dimethyl- phenyl acetate (unsym-m- Xylenyl acetate)	226 (cor )		1 499015	1 029815 5	164	166	118 2	27	211 5 (cor)	82	153, 147	164 6 (cor), 95°, al	
225	,	226		1 426	0 873	186	31 5	268 70	97	64 65	108 100 1	78	108 (cor), al	
226	,	226 16	-50, -47	1 42280 <sup>15</sup> He (yel)	0 86349	186	-39	205 35	-78 5	138 (cor)	100 1	74 5	46 4	
227	n-Butyl n-enan- thate (n-Butyl n-heptanoate)	226 2		1 4228015	0 86382	186	-7 47	223	-90 2	117 6, 116	96 96 5	81	64 62 5	
228		226 3	-63 1	1 4228615	0 86345	186	-34 5	186 35	-51 6 -46 1	157 5	106	74	58 4 (cor)	
229	n-Propyl n- caprylate (n- Propyl n- octanoate)	226 43	-46 2	1 4235115 He (yel)	0 86591	186	16 3	237 239 3		97 1	110 106	57	74, pet eth	ì
230	Ethyl 2-toluate (Ethyl 2-methyl benzoate)	227		1 507216	1 032541 5	164	104-5, 107-8	259751	-1173	78 32	142 8 (cor)	144	93, al	
231		227	α -55 0, β -36 7	1 42200	0 8657	186	12 3	254 4	-117 3	78 32	99	84	93, al	N-(β-Amino- ethyl) mor- pholide, 61 3
232	I-Menthyl acetate	227	·		0 9185	198	16 6	118 2	43	216	82	153, 147	153	0, 3
233	Ethyl phenyl- acetate	227 5		1 49921 18 5	1 0333	164	76 5, subl	256 5 (cor)	-1173	78 32	156	135-6	93, al	N-(β-Amino- ethyl) mor- pholide, 88 9
	n-Octyl propionate	227 9	-416	1 421851 <sup>3</sup> He (yel)	0 86633	186	-20 8	141	~16, -167	195	81, 81 3, 79	126, 1 <b>2</b> 3	61-2	
235	Diethyl itaconate	228		1 4377	1 0467	93	165		-1173	78 32	di 1912- 8, al		93, al	
			L		<u></u>	<u></u> _			L	L			L	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### Including esters of inorganic acids

								Saponifica	tion		T	<u> </u>		
No	Name	Boiling point,	Melting point,	n 20	D20	F	A	cıd	Alc	ohol	Amide	<i>p</i> - Tolui	3 5 Di nitro-	Miscellaneous
		°C	,c			Equiv alent	MP,	BP, °C	MP, °C	BP, °C		dide	benzoate	
236	Diethyl mesa- conate	229		1 4488	1 0453	93	204 5 (cor ), subl		-117 3	78 32	mono (α) 222 (β) 174 dι 176 5	mono (α) 196 di 212, al	93, al	
237	Di-isobutyl oxalate (Isobutyl oxalate)	229		1 4180	0 97373	101	189 5 (anh), 101 (+2 H <sub>2</sub> O)			108 1	mono 219 di 419d	mono 169 di 268	87	
238 239	Allyl benzoate Isobutyl levulinate	230 230 9		1 067‡ 1 42677	1 0578¦\$  0 96770	162 172	122 4 33 5	249 245 6		97 I 108 I	130 107 8d	158 108 9, w	49 50 87	Semicarbazone, 112 3, Phenylhydrazone, 84 6, 2,4-Dinitrophenylhyddrazone, 55 6, Oxime, 96
240	n-Propyl benzoate	231		1 500	1 023	164	122 4	249		97 1	130	158	74, pet eth	Oxime, 70
241	Diethyl citra- conate	231		1 4442	1 0491	93	92d , eth lgr	206 11 sl d	-117 3	78 32	100 1		93, al	1-Naphthyl- amide, 169- 70
242	Methyl 3-chloro- benzoate	231				170 5	158, 155		-97	64 65	134		108 (cor ),	70
243	$\beta$ -Phenylethyl acetate	232 224		1 5108	1 057225	164	16 6	118 2	-25 8	2198	82	153 147	al 108	
244		232	14	1 5286	1 089115	166	141	286	-117 3	78 32	168 9, w		93, al	
245	Di-(β-methoxy- ethyl) carbonate	232		1 419320	1 093625	178	:	,		124 5	:			
246	Di-isoamyl car- bonate	233 (cor )		1 4174	0 9067	202	98	302-4	-117	132	dı	4. 210	61 93, al	N-(β-Amino-
247	Diethyl glutarate	233 66	-238	1 02229	1 42395	94	98	302-4	-1173	78 32	175-6	di 218	93, ai	ethyl) mor- pholide,
248	Ethyl 3-toluate	234		1 505214	1 0265214	164	111 3, 110 1	263, subl	-117 3	78 32	94, 97	118	93, al	152 7
249	Ethyl salicylate	234		1 52542	1 1396	166	158 3, subl-at		-1173	78 32	142, 139	156	93, al	
250	Methyl 2-chloro- benzoate	234	-	i		170 5	76 142, 144		~97	64 65	142, 202	131	108, (cor ), al	
251	Ethyl 4-toluate	234 5		1 508918 2	1 026918 2	164	179 80, subl	275 (cor)	-1173	78 32	160, 158	160, 165	93, al	
252	Diethyl bromo- malonate	235			1 426};	239	113d	(601)	-1173	78 32	di 181, al	di 217, ac a	93, al	

<sup>\*</sup>Derivative data given in order m p crystal color, solvent from which crystallized

# Including esters of inorganic acids

	ļ	1		l	Į.		S	aponıficat	ion		ļ			ļ
No	Name	Boiling point,	Melting point,	n20	D <sup>20</sup>	Equiv-	Ac	ıd	Alco	hol	Amide	<i>p</i> − Toluı	3 5-Di nitro-	Miscellaneous
		°C	·c			alent	MP, °C	BP. ℃	MP, °C	BP.		dide	benzoate	
253	Ethylene glycol di-n-butyrate	235-7749		1 42619не	1 0005	101	-5 5, -8	162 5, 164	-78 5	138 (cor)	115 6	75	46 4	
254	•	235-40			1 425	101		104	-1173	78 32	di 200		93, al	
255	2,4,6-Trimethyl- phenyl acetate (Mesityl acetate)	236				178	16 6	118 2	70, 69	220	82	153 147	į į	
256	2,5-Dimethyl- phenyl acetate (p-Xylenyl acetate)	237768			1 026415	164	16 6	118 2	74 5	212	82	153, 147	137 2 (cor), al	
257	· '	237 8		1 42905	0 97353	172	33 5	245-6	90 2	117 6,	107 8d	108-9, w	64, 62 5	Semicarba- zone, 102- 3, Phenyl- hydrazone, 79 81, 2,4-Dinitro- phenylhyd- razone, 65 8, Oxime, 96
258	Benzyl n-butyrate	238–40			1 03316	178	-5 5, -8	162 5, 164	-15 3	205 5	115-6	75	113	J
259	Methyl hydro- cinnamate (Methyl β- phenylpro- pionate)	239			1 0455°	164	48 7, 40	279-80 (cor)	-97	64 65	105, 82	135	108 (cor), al	
260		239, 249-51		1 51610	1 0979	180	158 3			97 1	142, 139	156	74, pet eth	
261	Guaiacol acetate (2-Methoxy- phenyl acetate)	240		1 510125	1 128525	166	16 6	118 2	32, 28 2	205	82	153, 147	141 2 (cor), al	
262		240–2, 237		1 50650	1 0729	180	158 3, subl at 76		-89 5	82 4	142, 139	156	123, pet eth	
263	Dimethyl /-malate	242		1 4425	1 2334	81	100-1		-97	64 65	di 156–7	dı 206-7	108	$[\alpha]_{D}^{20} -6.85$
264	Geranyl acetate	242		1 4660	0 917415	196	16 6	1182		230	82	153, 147	62-3	
265	Isobutyi benzoate	242 2 (cor)			0 999	178	122 4	249		108 1	130	158	87	
266	Di-n-butyl oxalate (n-Butyl oxalate)	243, 245 5	-29 6	1 4240	0 98732	101	189 5 (anh), 101 (+ 2H <sub>2</sub> O)		-90 2	117 6, 116	mono 219, di 419d	mono 169, di 268	64, 62 5	
267	Methyl 2-bromo- benzoate	244				215	150		-97	64 65	155	_20	108 (cor), al	
268	n-Octyl n-butyrate	244 1	-55 6	1 4267415 He (yel)	0 86288	200	-55, -8	162 5, 164	-16, -167	195	115 6	75	61 2	
269	Ethy! n-caprate (Ethyl n- decanoate)	244 9	$\beta = 20,$ $\gamma$ $= 30.6$	1 42575	0 8650	200	31 5		-117 3	78 32	108, 100 1	78	93, al	N-(β-Amino- ethyl) mor- pholide, 60 1

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### Including esters of inorganic acids

								Saponifica	lion					
No	Name	Boiling point	Melting point	п <sup>20</sup>	D <sub>4</sub> 0	Equiv	Ac	ad	Alco	hol	Amide	<i>p</i> - Toluı	3.5 Di nitro	Miscellaneous
		,c	°c	_		alent	MP, °C	B P *C	M P *C	B P °C		dide	benzoate	
270	Diethyl adipate	245, 133 8 <sup>15</sup>	-21	1 42765	1 0090	101	153-4 (cor)	21615	-1173	78 32	mono 125 30, w,	241	93, al	N-(β-Amino- ethyl) mor- pholide
271	Methyl phenoxy- acetate	245			1 1501-5	166	98 9	285d	- 97	64 65	101 5		(cor)	
272	Thymyl acetate	245			1 009°	192	166	118 2	51 5	233 5	82	153 147	103 2 (cor),	
273	Carvacryl acetate	245 (cor )		1 4912828	0 9895925	192	166	118 2	1	237 5	82	153, 147	83	
274	Diethylene glycol diacetate (β,β'- Diacetoxy di- ethyl ether)	245 51, 148 <sup>26</sup>		1 4348	1 1078 5	95	16 6	118 2	- 10 45	244 5	82	153 147	149 ac a	
275		245 02	-41 9, -43	1 42647 <sup>1</sup> 2 He (yel)	0 86278	200	16 3	237	-90 2	117 6 116	110 106	70	64 62 5	
276	valerate (n- Heptyl n-	245 2	-46 4	l 42536 <sup>15</sup> He (yel)	0 86225	200	-34 5	186 35	-34 6 -33 8	176 8	106	74	46 47	
277	pentanoate) n-Amyl n-enan- thate (n-Pentyl n-heptanoate)	245 4	-49 5	l 4262719 He (yel)	0 86232	200	<b>-747</b>	223	~78 5	138 (cor)	96 96 5	81	46 4	
278		245 4	-55 25	1 42637 <sup>15</sup> He (yel)	0 86216	200	-39	205 35	-51 6 -46 1	157 5	100 1	74 5	58 4 (cor)	
279		245 5		1 423925	1 063525	206				135			75, al	
280		246			0 983	204	16 6	118 2		228-30	82	153 147		
281	-	247			0 99918	192	76 5 (cor)	256 5 (cor)		108 1	156	135-6	87	
282	Ethyl hydrocinna- mate (Ethyl $\beta$ - phenylpro-	247 2			1 0147	178	40, 48 7	279-80 (cor)	-117 3	78 32	105,82	135	93, al	
283	pionate) Di-n-propyl succinate	248, 246	- 10 4	1 4252	1 011	101	185, 182 8	235d		97 1	mono 157, di: 260d , w	80, <i>di</i> : 254 5- 5 5,	74, pet eth	
284	Methyl 2-meth- oxybenzoate	248		1 53419 5	1 157119	166	100 1	200	-97	64 65	129	260	108 (cor), al	
285	Methyl undecylen- ate (Methyl hendecylenate)	248	-27 5	1 43928	0 88915	198	24 5	275	-97	64 65	87		al 108 (cor ), al	

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p , crystal color, solvent from which crystallized

# Including esters of inorganic acids

	!			[				Saponificat	lion					
No	Name	Boiling point, °C	Melting point,	n 20 D	D <sub>4</sub> 20	Equiv-	Ac	nd	Alco	hol	Amide	p- Tolui-	3 5-Di nitro-	Miscellaneous
		*c	°C			alent	МР, °С	B P °C	M P °C	B P °C		dide	benzoate	
286	Isoamyl levulinate	248 8		1 43102	0 96136	186	33 5	245 6	-117	132	107 8d	108 9, w	61	Semicarba- zone, 91-2, Phenylhyd- razone, 70 2, 2,4-Dinitro- phenylhyd- razone, 50 5 Oxime, 96
287	Diethyl acetone- dicarboxylate	250d			1 113	101	135		-117 3	78 32			93, al	Dianilide, 155, bz, Semicarba- zone, 94 5, Cu(OAc) <sub>2</sub> → Cu enolate, 142 3, grn bz
288	n-Butyl benzoate	250 3	-22 4	<u> </u>	1 000	178	122 4	249	-90 2	117 6, 116	130	158	64 62 5	Ì
289	Ethyl phenoxy- acetate	251			1 10417 5	180	98-9	285d	-1173	78 32	101 5		93, al	
290		252		1 52236	1 131	166	109-10		_ <b>97</b>	64 65			108 (сог), al	α-Phenyl- ethylamide, 128 6 9 0, Benzyl- amide, 111 8 2 8
291	Diethyl /-malate	253		1 4362	1 1290	95	100-1		-1173	78 32	dı 156 7	di 206 7	93, al	$[\alpha]_{D}^{20} - 10.18$
292	n-Amyl levulinate (n-Pentyl levulinate)	253 4		1 43192	0 96136	186	33 5	245 6	-78 5	138 (cor)	107 8d	108 9,	46 4	2,4-Dinitro- phenylhyd- razone, 84 2, Oxime, 96
293	n-Butyl phenyl- acetate	254		1 489	0 994	192	76 5, subl	256 5 (cor)	-90 2	117 6, 116	156	135 6	64, 62 5	Oxime, 70
294	β-Methoxyethyl benzoate (Methyl "cellosolve" benzoate)	255		1 504025	1 089125	180	122 4	249		124 5	130	158	<b>02</b> 3	4-Nitro- benzoate, 50 5, dil al
296	Diethyl pimelate	255	-23 8	1 42985	0 9929	108	105	22315	-117 3	78 32	dı 175	<i>dı</i> 206, al	93, al	N-(β-Amino- ethyl) mor- pholide,
297	Ethyl benzoyl- formate	256-7		1 519025	1 22225	178	66		-1173	78 32	91		93, al	Phenylhyd- razone, 64, 2,4-Di- nitro- phenylhyd- razone, 196 7d (cor)

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# Including esters of inorganic acids

			l					Saponifica	tion		]			
No	Name	Boiling point, °C	Melting point	n 20 D	D20	Equiv-	A	cıd	Alc	ohol	Amide	<i>p</i> Tolui	3 5 Di nitro-	Miscellaneous
		°C	°C			alent	M P °C	B P °C	M P °C	B P °C		dide	benzoate	
298	Glyceryl triacetate	258			1 16115	72 7	166	118 2	179	290d	82	153 147		Tris-4-nitro- benzoate, 188
299	Ethyl 3-methoxy- benzoate	260		1 5161	1 0993	180	109 10		-117 3	78 32			93, al	Benzyl- amide, 111 8 2 8, α- Phenyl- ethylamide, 128 6 9 0
300	β-Ethoxyethyl benzoate ("Cellosolve" benzoate)	260-1738 5		1 496925	1 058525	194	122 4	249		135	130	158	75, al	128 0 9 0
301	Isobutyl salicylate	260 2		1 50872	1 0639	194	158 3, subl at 76			108 1	142, 139	156	87	
302	n-Amyl n-capryl- ate (n-Pentyl n- octanoate)	260 21	-34 8	1 43019 <sup>15</sup> He (yel)	0 86132	214	16 3	237 239 3	-78 5	138 (cor)	110, 106	70	46 4	
303		260 9	-47 9	1 429391 He (yel)	0 86114	214	-7 47	223	-51 6, -46 1	157 5	96, 96 5	81	58 4 (cor)	
304	n-Heptyl n- caproate (n- Heptyl n- hexanoate)	260 97	-34 4	1 42934 <sup>15</sup> He (yel)	0 86115	214	-39	205 35	-34 6, -33 8	176 8	100 1	74 5	46 47	
305	Ethyl 2-methoxy- benzoate	261		1 5224	1 1124	261	100 1	200	-1173	78 32	129		93, al	
306	n-Octyl n-valerate (n-Octyl n pentanoate)	261 1	-42 5	1 4274315 He (yel)	0 86148	214	-34 5	186 35	16 16 7	195	106	74	61 2	
307 308	Isoamyl benzoate	262 3 263		1 4950 1 46334 <sup>16</sup> °	I 004 I 0747	192	122 4 187 5 8 0	249	– 117 – 97	132 64 65	130 $mono$ ( $\alpha$ - amide $\beta$ - acid), 176, ( $\beta$ - amide- $\alpha$ - acid), 182 3, $di$	158 α 212 4, β 190-6	61 108 (cor), al	
309	Ethyl undecylenate (Ethyl hendecylenate)	264		1 444923	0 88271 15	212	24 5	275	-117 3	78 32	192-3 87		93, al	
310	Isobutyl succinate	265		1 427	0 974	115	185, 182 8	235d		108 1	mono 157, di 260d , w	mono 179 80, di 254 5 5 5, 260	87	

 $<sup>\</sup>begin{tabular}{ll} \be$ 

## Including esters of inorganic acids

		<u> </u>					S	aponificat	ion					<u> </u>
No	Name	Boiling point	Melting point	n 20	D <sup>20</sup>	Equiv	A	eid	Alu	ohol	Amide	<i>p</i> - Tolui	3.5 Di nitro	Miscellaneous
		°C	·c	,		alent	MP, °C	B P °C	M P °C	BP. ℃		dide	benzoate	
311	Ethyl benzoyl- acetate	265 sl d , 270 d		1 5498	1 116	192			-1173	78 32			93, al	Ketone cleavage → aceto- phenone, m p 19 65, b p 202
312	Di-isoamyl oxa- late (Isoamyl oxalate)	267 8, 262		1 427	0 961	115	189 5 (anh ) 101 (+ 2H <sub>2</sub> O)	:	-117	132	mono 219, di: 419d	mono 169, di 268	61	•
313	Dimethyl suberate	268	-5	1 43326	1 0198	101	144, 139-41		-97	64 65	mono 125 7, di 216 7	di 218, 219	108 (cor), al	
314	Methyi laurate	268		1 432	0 870	214	44, 42	299	-97	64 65	100, 99	87	108 (сог), al	$\beta$ -Naphthol $\rightarrow \beta$ -  naphthyl methyl ether, 72
315	Ethyl 4-methoxy- benzoate (Ethyl anisate)	269	7	1 5254	1 1038	180	184 6, 184 2 (cor)	275 80	-117 3	78 32	167, 162 3, w	186	93, al	N-(β-Amino- ethyl) mor- pholide,
316 317		269 270	-17	1 4321	0 8671   \$	228 72	44, 42 194-5 (cor) d	299	-117 3 -97	78 32 64 65	turns br at 250, sinters at 260	87	93, al 108 (cor ), al	
318	n-Butyl salicylate	270–2, 268		1 51148	1 0728	194	158 3, subl at 76		- <b>9</b> 0 2	117 6, 116	142, 139	156	64, 62 5	
319	Ethyl cinnamate	271	6 70	1 55982	1 0490	176	133	300	-117 3	78 32	147-8	168	93, al	N-(β-Amino- ethyl) mor- pholide, 121 9
320	Di-n-butyl suc- cinate	274 5	-29 3	1 4298	0 9760	115	185, 182 8	235d	<b>-90 2</b>	117 6, 116	monວ 157, di: 260d , ພ	mono 179 80, di 254 5 -5 5, 260	64, 62 5	
321	Ethyl 2-nitro- benzoate	275	30		ļ	195	146	ŧ	-1173	78 32	176		93, al	
322		275d		1 45562	1 1064	86	194-5 (cor)		-1173	78 32	tri turns br at 250, sinters at 260		93, al	
323	Di-isopropyl <i>d-</i> tartarate	275			1 1274	117	169 71		-89 5	82 4	mono 171-2, di 196d ,		123, pet eth	$[\alpha]_D^{20}$ +14 886, Phenylhyd- razide, 240
324	Ethyl 4-ethoxy- benzoate	275			l 076²¹	194	198, 195-6		-1173	78 32	al 202		93, al	Hydrazide, 126-7, al

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## Including esters of inorganic acids

							s	aponificat	ion					
No	Name	Boiling point	Melting point	n 20 D	D‡º	Equiv	Ac	nd	Alco	ohol	Amide	p Tolui	3 5 Di nitro	Miscellaneous
		•c	*c	-		alent	M P °C	B P °C	M P °C	B P °C		dide	benzoate	
325	n-Octyl n-caproate (n Octyl n hexanoate)	275 2	- 28 4	1 43256 <sup>15</sup> He (yel)	0 86032	228	-39	205 35	-16 -167	195	100 1	74 5	61 2	
326		276 8		1 50799	1 0535	208	158 3 subl at 76		-117	132	142 139	156	61	
327	n-Heptyl n-enan- thate (n Heptyl n heptanoate)	277 2	-33 3	1 43183 He (yel)	0 86039	228	-7 47	223 0	-34 6 -33 8	176 8	96 96 5	81	46 47	
328	n-Hexyl n- caprylate (n Hexyl n octanoate)	277 44	-30 6	1 43230 <sup>1</sup> He (yel)	0 86033	228	16 3	237 239 3	-51 6 -46 1	157 5	110 106	70	58 4 (cor)	
329	·	278 sl d			1 179	97	166	1182	110 (stab) 108 8 5 (labile)	280 8 (cor)	82	153 147	dı 201	
330	Diethyl suberate	282	5 9	1 43236	1 9807	115	144 139 41		- 117 3	78 32	mono 125 7 di 216-7	dı 218-9	93 al	N-(β-Amino- ethyl) mor- pholide,
331	Resorcinol mono- acetate	283				152	16 6	118 2	110 (stab ) 108- 8 5 (labile)	280 8 (cor)	82	153 147	dı 201	137 2
332	Dimethyl phthalate (Methyl phthal ate)	283 8		1 5138	1 191	97	200 6 191 (sealed tube)		~97	64 65	mono 149 di 220	mono 150 (slow htng) 160 5 (rapid htng)		
333	Diethyl iso- phthalate	286733	11 5			111	348 (subl )		-1173	78 32	mono 280 di 280	ining)	93 al	
334	Diethyl <i>d-</i> cam- phorate	286		1 45354 <sup>26</sup> <sup>2</sup>	1 0298	128	187 5- 8 0		-1173	78 32	mono (α amide β- acid) 176 (β	α 212- 4 β 190-6	93, al	
											amide- α- acid) 182 3, dt	-		
335	Glyceryl tri- propionate	289			1 08319	86 7	-20 8	141	179	290d	192 3 81 81 3, 79	126 123		Tris-4-nitro- benzoate, 188

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## Including esters of inorganic acids

							S	Saponificat	ion		_			
No	Name	Boiling point, °C	Melting point	n 20 D	D <sup>20</sup>	Equiv	Ac	ıd	Alco	hol	Amide	<i>p</i> - Tolu₁-	3,5-Di- nitro-	Miscellaneous
		°C	,c			alent	M P °C	B P °C	M P °C	BP, ℃		dide	benzoate	
336	<b>Diethyl phthalate</b> (Ethyl phthal- ate)	289 5, 298		1 5019	1 1175	111	200 6, 191 (sealed tube)		-117 3	78 32	mono 149, di 220	mono 150 (slow htng), 160 5 (rapid htng)	93, al	
337	n-Heptyl n- caprylate (n- Heptyl n- octanoate)	290 6	-10 2	1 434921 He (yel)	0 85958	242	16 3	237 239 3	-34 6, -33 8	176 8	110, 106	70	46, 47	
338		290 8	-21 5	l 434881 He (vel)	0 85961	242	-747	223 0	-16, -167	195	96, 96 5	81	61 2	
339	Diethyl azelate	291	-18 5	1 43509	0 97294	122	106 5	> 360 sl d 23712	-117 3	78 32	mono 93 5 di 175	dı 201-2	93 al	N-(\beta-Amino- ethyl) mor- pholide, 141 3
340	Triethyl citrate	294		1 44554	1 1369	92	153 (anh) 100 (+1 H <sub>2</sub> O)		-1173	78 32	tri 210 5d, w	<i>tri</i> 189, al	93, al	
341	Ethyl myristate	295	α 11 9 β 12 3	1 4362	0 857323	256	53 9	20216	-1173	78 32	103	93	93, al	N-(β-Amino- ethyl) mor- pholide, 76
342	Di-n-propyl d- tartarate	297			1 1390	117	169 71			97 1	mono 171-2, di 196d,		74, pet eth	$[\alpha]_{p}^{20}$ +12 00, Phenylhyd- razide, 240
343	Isoamyl succinate	297		1 434	0 958	129	185 182 8	235d	-117	132	mono 157 di 260d,	mono 179- 80, di 254 5 5 5, 260	61	
344	11-	297 8		1 427925	0 976665	262					170 6743			
345		300			1 07715	125	117d		-1173	78 32	225		93, ai	
346	malonate α-Tetrahydro- furfuryl ben-	300 2 50			1 137%	206	122 4	249		177 8 <sup>743</sup>	130	158	83-4	
347	zoate Di-isopropyl phthalate (Iso- propyl phthalate)	302			1 06519	115	200 6, 191 (sealed tube)		-89 5	82 4	mono 149 di 220	mono 150 (slow htng ), 160-5 (rapid	123, pet eth	
348	n-Octyl n- caprylate (n- Octyl n- octanoate)	306 8	-151	l 43698 <sup>15</sup> He (yel)	0 85919	256	16 3	237, 239 3			110, 106	htng) 70	61 2	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

### Including esters of inorganic acids

							:	Saponifica	ition					
No	Name	Boiling point,	Melting point	n <sup>20</sup>	D20			cıd	Alc	ohol	Amide	<i>p-</i> Tolui	3,5-Di nitro-	Miscellaneous
		°C	°C	, D		Equiv- alent	МР, °С	B P °C	MP,	B P °C		dıde	benzoate	
349	Diethyl sebacate	307	1 3	1 43657	0 9631	129	33, subl	24315	-117 3	78 32	mono 170 di 210, 208	dı 201	93, al	
350	2-Tolyl benzoate ("o-Cresyl" benzoate)	307			1 11419	212	122 4	249	31	191 2	130	158	138 4 (cor), al	
351	· '	309			1 1274 15	200	161 2 (cor)		-1173	78 32	202 205		93, al	
352	Glyceryl tri- butyrate	318			1 0331	100 7	-55 -8	162 5, 164	179	290d	115 6	75		Tris-4-nitro- benzoate, 188
353	Di-n-butyl d,l- tartarate (Di-n- butyl racemate)	320			1 08791*	131	205 6 (anh), 203-4 (+1 H <sub>2</sub> O)		-90 2	117 6, 116	di 226, w-me al		64, 62 5	Dianilide, 235~6
354	Benzyl salicylate	320				228	158 3, subl at		-153	205 5	142, 139	156	113	
355	Di-n-butyl phthalate (n Butyl phthalate)	340 7		1 4900	1 04720	139	200 6, 191 (sealed tube)		-90 2	117 6, 116	mono 149, di 220	mono 150 (slow htng), 160 5 (rapid htng)		N-(β-Amino- ethyl) mor pholide, 124
356	Di-n-butyl sebacate	345			0 932915	157	133, subl	24315	-90 2	117 6, 119	mono 126 5, di 210, 208	di 201	64, 62 5	Phenylhyd- razide, 194
357	Di-isoamyl phthal- ate (Isoamyl phthalate)	349			1 02417	153	200-6, 191 (sealed tube)		-117	132	mono 149, di 220	mono 150 (slow htng), 160-5 (rapid htng)	61	
358	Tricresyl phos- phate	400d , 275 80 <sup>20</sup>	-30	1 5568	1 19725	122 7			36	202 32		,	188 6 (cor ), al	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## Reduced pressure b.p. only

a) Liquids. 2) (Listed in order of increasing m.p. of the corresponding amide)\*

							S	aponifica	tion			İ		1
No	Name	Boiling point	Melting point,	n 20	D20	-	A	cıd	Alc	ohol	Amide	p- Tolui	3 5-Di nitro-	Miscellaneous
		°C	,.c			Equiv- alent	M.P., °C	B P	MP,	BP,	1	dide	benzoate	
1	3,5-Dimethylphenyl acetate (Sym-m- Xylenyl acetate)	130 <sup>26</sup> , 120 <sup>11</sup>				164	16 6	118 2	63 2 68	220 2	82	153, 147	195 4, al	
2	1 7 7	156 <sup>20</sup> , 146 2 <sup>10</sup>		1 43607	1 0069	108	106	>360 sl d	-97	64 65	mono 93 5, di 172	dı 201 2, 198	108 (cor),	
3	Dimethyl adipate	107 611	8 5	1 4277	1 0625	87	153 4 (cor)	21615	-97	64 65	mono 125 30, w,	241	108 (cor), al	
4	β-n-Butoxyethyl ben- zoate (Butyl "cello- solve" benzoate)	156 5 7 0 <sup>14 5</sup> , 131 6 2 6 <sup>3 0</sup>		1 492525	1 0277≰	222	122 4	249		170 6***	130	158		4-Nitro- phenylure- thane, 58 7 9 1, CCI <sub>4</sub>
5	Ethyl furoylacetate	170 <sup>20</sup> 143 <sup>10</sup>		1 505516	1 165 17				-117 3	78 32	159, al		93, al	Oxime, 131 2, dd al
6	Methyl furoylacetate	144 5 <sup>20</sup> , 96–8 <sup>1</sup>							-97	64 65	159, al		108 (cor ), al	Semicarba- zone, 141- 2, bz -al (3 1), Oxime, 124 5, bz
7	Di-n-propyl adipate	15516	-20	1 4314	0 9790	115	153 4			97 1	mono 161 di 220	dı 241	74, pet eth	124 3, 02
8	Dimethyl pimelate	119 3 9 6 10	-206	1 42888	1 0383	94	105		-97	64 65	di 175	di 206, al	108 (cor ),	
9	Di-n-propyl maleate	11476		1 444 <sup>1# 3</sup>	1 026	100	137			97 1	di 181, me al	mono 195d , chl , di 142, eth	al 74, pet eth	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		T			S	Saponifica	tion		<u> </u>			
No	Name	Melting point,	Boiling point,		Ac	ıd	Alco	ohol	Amide	p-	3 5-Di- nitro-	Miscellaneous
,		°C	°C	Equiv	MP, °C	BP, ℃	M P	B P °C		Toluidide	benzoate	
1	Dimethyl succinate	18 2	196	73	185, 182 8	235d	-97	64 65	mono 157, di 260d	mono 179 80, di 254 5 5 5 260	108 (cor ), al	ng 141965 D4 11192
2	Methyl myristate	18 5	323	242	53 9	20216	- 97	64 65	103	93	108 (cor ),	n <sub>D</sub> 1 428
3	Ethyl piperonylate	18 5	286	194		228, 229	-117 3	78 32	169, al		93, al	
4	Diethyl <i>d-</i> tartarate	18 6	280	103	169 71		-1173	78 32	mono 171-2, di 196d, al		93, al	n <sup>60</sup> <sub>2</sub>   144677, D <sup>40</sup> <sub>4</sub>   12028 [α] <sup>20</sup> <sub>Hg</sub> (grn) + 787, Phenylhydrazide, 204
5	Phenyl propionate	20	211	150	- 20 8	141	41 8 42	182 183	81	123 126	145 8 (cor), al	D ½; 1 0467, Tri- bromo, 95
6 7	Ethyl margarate Methyl 3-chloroben- zoate	20 6 (β) 21	231	298 170 5	61 2 158, 155	23116	-117 3 -97	78 32 64 65	108, 106 134		93, al 108 (cor ), al	
8	Benzyl benzoate	21	323-4 (cor)	212	122 4		-153	205 5	130	158	113	ngi 1 5681, D <sup>19</sup> 1 1224
9	Di-n-butyl d-tartarate	22		131	169 71		<b>-90 2</b>	117 6, 116	mono 171-2 di 196d, al		64, 62 5	D <sub>4</sub> * 1 0886, [α] <sub>0</sub> * + 10 09, Phenylhyd- razide, 240
10	3,4-Dimethylphenyl acetate	22	235	164	16 6	118 2	62 5	225	82	153, 147	181 6, rods, al	E
11	Isobutyl stearate	(a) 22 5, (b) 28 9, (two forms)		340	70 1			108 1	109, 108 4, al	102	87	
12	Isoamyl stearate	23		354	70-1		-117	132	109, 108 4, al	102	61	
13	Cetyl acetate (n-Hexadecyl acetate)	α 185, β 242, 22		284	16 6	118 2	49 27	190¹ĸ	82	153, 147	66	
14	Ethyl palmitate	α 194, β 242	185	284	62 7	22216	-117 3	78 32	106-7, 105 3, al	98	93, al	
15	Methyl anthranilate (Methyl 2-aminoben- zoate)	24 4	299 8	151	146		-1173	78 32	109	151	93, al	N-(β-Aminoethyl) morpholide, 126, Picrate, 106
16	Di-n-propyl d,l-tartarate	25	286765	117	203-4 (+1 H <sub>2</sub> O), 205-6 (anh)			97 1	226, w - me al		74, pet eth	D4º 1 1256
17	Dimethyl sebacate	26 6, 27-8		115	133, subl	24315	97	64 65	mono 170, di 210, 208	di 201	108 (cor ), al	n∯ 1 43549, Dૄ 0 98818, Phenylhydrazide,

<sup>\*</sup>Derivative data given in order  $\, m \, p$  , crystal color, solvent from which crystallized

				T	S	aponificat	tion					
No	Name	Melting point,	Boiling point,		Ac	ıd	Alco	hol	Amide	p-	3,5-Di- nitro-	Miscellaneous
140	Name	°C	*C	Equiv- alent	M P °C	BP.	M P, °C	BP,	Aimac	Toluidide	benzoate	Miscenaneous
18	Methyl β-(2-furyl) acrylate	27	227	152	141	286	-97	64 65	168 9		108 (cor),	
19	n-Butyl stearate	27 5, 28		340	70 1		-90 2	1176,	109 108 4, al	102	al 64 62 5	
21	d-Bornyl acetate	29	226, 221	196	16 6	118 2	204 5 5 5	212	82	153, 147	154	ng 6 1 4633, D4 0 991
22	Methyl margarate	29		284	61 2	23116	-97	64 65	108, 106		108 (cor),	(undercooled)
23	Eugenyl acetate	30	282	206	166	118 2	-91	253	82	153, 147	130 8 (cor), 95% al	n <sup>20</sup> 1 52069 D¦, 1 087
24	Methyl palmitate	30	18412	270	62 7	22216	-97	64 65	106 7 105 3, al	98	108 (cor),	n <sup>45</sup> 1 4317
25	n-Amyl stearate (n-Pentyl stearate)	30		354	70 1		-78 5	138 (cor)	109, 108 4, al	102	136 (cor )	
26 27	Ethyl 2-nitrobenzoate n-Octadecyl acetate	30 α 29 97, β 31 95	275	195 312	146 16 6	118 2	-177 3 α 57 95, 59 5	78 32 210 515	176 82	153, 147	93, al 66	$\beta$ -Form exist below $0^{\circ}$ , $\alpha$ -Form seeding with crys or cooling soln of the compound
28	Ethyl 2-naphthoate	32	304	200	184, 185 5		-1173	78 32	192-3, 195, at	192, al	93, al	ngo 1 596, D <sub>4</sub> <sup>20</sup> 1 117
29	Methyl-3-bromo- benzoate	32		229	155		-97	64 65	155		108 (cor), al	
30	Methyl 4-toluate	33	222 5, 217	150	179-80, subl	275 (cor)	-97	64 65	160, 158	160, 165	108 (cor),	
31 32	Thymyl benzoate Di-(β-ethoxyethyl) phthalate	33 33		255 155	122 4 200 6, 191 (sealed tube)		51 5	233 5 134 8	130 mono 149, di 220	158 mono 150 (slow htng), 160-5 (rapid htng) di 201	103 2, al 75, al	
33	Ethyl stearate	α 30 9, β 33 5	19910	312	70-1		-1173	78 32	109, 108 4, al	102	93, al	$\alpha \rightarrow \beta$ Slowly on rubbing, N-( $\beta$ -Aminoethyl)
34	Di-isopropyl d,l-tartarate	34	275765	117	203 4 (+ 1H <sub>2</sub> O), 205-6		-89 5	82 4	226, w - me , al		123, pet eth	morpholide, 58 D <sub>4</sub> ° 1 1166
35	Ethyl pyromucate (Ethyl furoate)	34	197	140	(anh ) 133 4, 132	230-2	-117 3	78 32	142-3	170 5, al	93, al	n <sub>D</sub> 1 4797, D <sub>4</sub> 0 8 1 1174 (undercooled)
36	Diethyl 4-nitrophthalate	34		133 5	165		-117 3	78 32	200 d	mono	93, al	· ·
37	Ethyl benzilate	34		256	150		-1173	78 32	153, chl	172 189-90	93, al	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

		1		}	S	aponifica	tion		1	1	1	
No	Name	Melting point,	Boiling point	F	Acı	d	Alco	hol	Amide	p- Toluidide	3 5-Di- nitro	Miscellaneous
		·•c	· °C	Equiv alent	M P °C	BP, °C	M P - °C	B P °C	]	Tolulaide	benzoate	
38	2,4,5-Trimethylphenyl acetate (Pseudocu- menyl acetate)	34–4 5	245 6	178	16 6	118 2	71	232	82	153, 147		
39	Methyl cinnamate	36	261	162	133	300	-97	64 65	147 8	168	108 (cor) al	
40 41	Ethyl d,l-mandelate Dimethyl itaconate	37 38	254 208	180 79	118 165		-117 3 -97	78 32 64 65	133 4 di 191 2 8, al	172, al	93, al 108 (cor),	n <sup>20</sup> 1 44413 D <sub>4</sub> <sup>18</sup> 1 12410
42	Methyl sebacate	38	288d	216	133, subl	24315	-97	64 65	mono 170, di 210, 208	dı 201	108 (cor), al	Phenylhydrazide, 194
43	Methyl stearate	38 8	214-515	298	70-1		<b>-97</b>	64 65	109, 108 4, al	102	108 (cor), al	
<b>4</b> 4	Benzyl cinnamate	39		238	133	300	-153	205 5	147	168	113	
45	Methyl dibenzylacetate	41		254	89		-97	64 65	128 9, bz	175, abs	108 (cor), al	
46	Phenyl salicylate (Salol)	42		214	158 3, subl at 76		41 8, 42	182, 183	142 139	156	145 8 (cor), al	Tribromo deriv of phenol, 95
47	Benzyl succinate	42		208	185 182 8	235d	-15 3	205 5	mono 157, di 260d	mono 179 80, di 254 5 5 5, 260	113	
48	Dibenzyl phthalate	43 -		173	200 6, 191 (sealed tube)				mono 149, di 220	mono 150 (slow htng), 160 5 (rapid htng), di 201	113	
49	Diethyl terephthalate	44	302	111	300, subl without melting		-117 3	78 32	>225		93, al	Dianilide, 334-7, PhNO <sub>2</sub>
50	Cinnamyl cinnamate	44	1	264	133	300	33	257	147-8	168	121	
51 52	Ethyl 2-nitrocinnamate Methyl 2-chloro- cinnamate	44 44		221 196 5	240 212, yel, al		-117 3 -97	78 32 64 65	185 168		93, al 108 (cor ), al	
53	Diethyl 3-nitrophthalate	46		133 5	218		1173	78 32	<i>dı</i> 201d	dı 226	93, al	N-(β-Aminoethyl) morpholide, 131 9
54	Ethyl 3-nitrobenzoate	47	296	195	140		-117 3	78 32	di 187, 189 90, dil me al		93, al	
55	Dicyclohexyl oxalate	47, 42		127	189 5 (anh ), 101 (+ 2H <sub>2</sub> O)		25 15	161 1	mono 219, di 419d	mono 168, di 268	112-3, al	
56	2-Phenylethyl cinnamate	47 8		252	133	300	-25 8	2198	147 8	168	108	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

			1		s	aponificat	ion					
No	Name	Melting point,	Boiling point,	Equiv-	Ac	ıd	Alco	hol	Amide	<i>p</i> - Toluidide	3 5 Di nitro	Miscellaneous
		·c	·c	alent	M P °C	BP,	M.P. ℃	B P ℃		, consider	benzoate	
58	1-Naphthyl acetate	48 49		186	16 6	118 2	94	278 80	82	153, 147	217 4, yel	
59	Methyl 4-methoxy- benzoate (Methyl anisate)	49, 45	255	166	184-6	275-80	-97	64 65	167, 162 5, w	186	al 108 (cor), al	
60	Phenacyl acetate (Benzoylcarbinyl acetate, ω-Acetoxy- acetophenone)	49		178	16 6	118 2	86	118 2011	82	153, 147	a1	
61	Di-3-tolyl carbonate (Di-"m-cresyl" carbonate)	49		242				12	203	i	165 4 (cor ),	
62	Triphenyl phosphate	49	26020	108 7			41 8, 42	182, 183			145 8 (cor ),	D <sub>4</sub> <sup>20</sup> 1 185, Tri- bromo deriv of phenol, 95
63	Dibenzyl d-tartarate	50		165	169-71		-15 3	205 5	mono 171 2, di 196d, al		113	Phenylhydrazide, 24
64	Dibenzyl succinate	51 2		149	185, 182 8	235d	-15 3	205 5	mono 157 di 260d	mono 179 80, di 254 5	113	
65	Methyl piperonylate	51-2	270–1777	180	229, 228		<b>-97</b>	64 65	169, al	5 5, 260	108 (cor), al	
66	Cetyl palmitate (n- Hexadecyl palmitate)	51 6		480	62 7	22216	49 27	19018	106 7 105 3, al	98	66	
68	Furfuryl diacetate	52	220	99	166	118 2			82	153 147		Hydrolysis → furfural, b p, 161 Semicarbazone, 202
59 70	Ethylene glycol dilaurate Phenyl stearate	52 52		213 360	44, 42 70-1	299	-12 6 41 8,42	197 85 182, 183	100, 99 109, 108 4, al	87 102	169 145 8 (cor ), al	Tribromo deriv of phenol, 95
71	Methyl d l-mandelate	53 3	250 sl d	166	118		-97	64 65	133-4	172, al	108 (cor), al	
72	Dimethyl tartronate	53 4		74	156-8d		-97	64 65	<i>dı</i> 198, dıl al		108 (cor ),	
73	Dimethyl oxalate	54	163 5262	59	189 5 (anh ), 101 (+ 2H <sub>2</sub> O)		-97	64 65	mono 219, di 419d	mono 168, di 268	108 (cor ), al	
14	Tetraethyl pyromellitate Diethyl <i>meso-</i> tartrate	54 55		91 5 103	275 140		-117 3 -117 3	78 32 78 32	di 187, 189-90, dil me		93, al 93, al	Bis-phenylhydrazid 245

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

b) Solids (Listed in order of increasing m.p.)\* (Continued)

			<u> </u>		S	aponificat	ion					
Nie	Nama	Melting	Boiling point,		Acı	d	Alco	hol	Amıde	p-	3 5-Dı- nıtro	Miscellaneous
No	Name	°C	°C	Equiv alent	MP,	BP, °C	M P	B P °C	Ailliuc	Toluidide	benzoate	Miscellanoous
76	3-Tolyl benzoate ("m- Cresyl" benzoate)	55	314	212	122 4	249	12	203	130	158	165 4 (cor),	
77	Ethyl 4-nitrobenzoate	56	186 3	195	241		~1173	78 32	201, 198	204, 192	93, al	N-(β-Aminoethyl) morpholide, 186 3
78	1-Naphthyl benzoate	56		248	122 4	249	94	278-80	130	158	217 4, yel, al	,
79	Cetyl stearate (n- Hexadecyl stearate)	56 6		508	70-1		49 27	19018	109, 108 4, al	102	66	
80	Di-isobutyl <i>d,l-</i> tartarate	58	311	131	203 4 (+ 1H <sub>2</sub> O), 205 6 (anh)	,		108 1	di 226, w-me al		87	
81 82	Ethyl diphenylacetate Ethyl 2-benzoylbenzoate	58 58		240 254	148 128 (anh ) 91 (+ 1H <sub>2</sub> O),		-117 3 -117 3	78 32 78 32	167 5 8 0 165 (cor), 162	172 3	93, al 93, al	N-(β-Aminoethyl) morpholide, 150 2
83 84	Diethyl naphthalate Methyl diphenylacetate	58 60 60		136 226	w 274 148		-117 3 -97	78 32 64 65	167 5 8 0	172 3	93, al 108 (cor), al	
85	Di-2-tolyl carbonate (Di- "o-cresyl" carbonate)	60		242	Į.		30 75	190 8			138 4 (cor),	
86	Methyl 2-(4-toluyl)- benzoate	61		254	139-46		<b>-97</b>	64 65	175 6, al		108 (cor ),	
87	Dimethyl d-tartarate	61 5		89	169 71		-97	64 65	mono 171 2, di 196d , al		108 (cor ), al	Two other forms, m p 48 and 50, Phenylhydrazide, 240
88	Ethylene glycol	63 0		241	53 9	20216	-126	197 85		93	169	
89	dimyristate Dimethyl 4-nitro- phthalate	66		119 5	165		-97	64 65	200d	<i>mono</i> 172	108 (cor),	
90	Dicyclohexyl phthalate	66		165	200-6 191 (sealed tube)		25 15	161 1	mono 149, di 220	mono 150 (slow htng), 160-5 (rapid htng), di 201	1	n <sup>20</sup> 1 451, D <sup>20</sup> 1 383
92 93	Ethyl oxanilate Dimethyl isophthalate	66-7 67 8		193 97	148 9 348, subl		-117 3 -97	78 32 64 65	228 mono 280, di 280	ju	93, al 108 (cor ), al	
94	Ethyl 2-(4-toluyl)ben- zoate	68, 69	314, 299	268	139–40		-1173	78 32	175 6, w		93, al	
95	Phenyl benzoate	69, 71	314	198	122 4	249	41 8, 42	182, 183	130	158	145 8 (cor), al	AICI <sub>3</sub> → 4-Hydroxy benzophenone, Tri- bromo deriv of phenol, 95

<sup>•</sup> Derivative data given in order m p, crystal color, solvent from which crystallized

					S	aponificat	ion					
No	Name	Melting point,	Boiling point,	F	Acı	d	Alco	hol	Amide	<i>p</i> - Toluidide	3,5-Dı- nıtro-	Miscellaneous
		°C	·°C	Equiv- alent	M P °C	B P °C	M P °C	B P 'C		1 olyldide	benzoate	
96	Dimethyl 3-nitro- phthalate	69		133 5	218		-97	64 65	<i>di</i> 201d	dı 226	108 (cor),	
97	Methyl 3-hydroxy- benzoate	70		152	200, subl		-97	64 65	170 167	163, dil al	al 108 (cor),	
98	Ethylene glycol di- palmitate	70 5 69		269	62 7	22216	-126	197 85	106 7 105 3, al	98	al 169	
99	2-Naphthyl acetate	71		186	16 6	118 2	123	285 6	82	153 147	210 2 al	
100	Glyceryl tristearate	71		297	70 1		179	290d	109 108 4	102	di	n <sup>№</sup> 1 4399 D <sup>№</sup> 0 862
101	4-Tolyl benzoate ("p- Cresyl" benzoate)	71	316	212	122 4	249	36	202	al 130	158	188 6 (cor ),	
102	Glyceryl tribenzoate	72, lgr , 76, al		135	122 4	249	179	290d	130	158	a i	
103	Phenyl cinnamate	72		238	133	300	41 8 42	182	147 8	168	145 8 (cor), al	Tribromo deriv of phenol, 95
104	Ethylene glycol diben- zoate	73	:	135	122 4	249	-126	197 85	130	158	di 169	
105	Methyl 2-nitro- cinnamate	73		207	240		-97	64 65	185		108 (cor),	
106	Di-isobutyl d-tartarate	73-4, 70		131	169 71			108 1	mono 171 2, di 169d , al		87	Phenylhydrazide, 240
107	Ethyl 3-hydroxy- benzoate	73 8	282	166	200, subi		-1173	78 32	170, 167	163, dıl al	93 al	
108	Diphenyl phthalate (Phenyl phthalate)	74-5, 70		159	200 6, 191 (sealed tube)		41 8, 42	182, 183	mono 149 di 220	mono 150 (slow htng), 160 5 (rapid htng), dr 201	145 8 (cor), al	Tribromo deriv of phenol, 95
109	Methyl 3-hydroxy-2- naphthoate	75		202	222-3 (cor)		-97	64 65	217 8 (cor ),	221-3	108 (cor),	
110	Methyl benzilate	75		242	150		-97	64 65	yel, al 154 5, chl	189 90	al 108 (cor),	
111	Ethylene glycol di-n- stearate	76, 73		297	70, 69 6		-126	197 85	108 4,	102	al 169	
112	Trimethyl citrate	76, 78 9	283 7d	78	100, 153 (anh )		-97	64 65	al tri 210- 5d, w	tri 189, al	108 (cor ),	
113	Methyl 2-naphthoate	77	290	186	184, 185 5		-97	64 65	192-3, al	192, al	al 108 (cor),	
114	Methyl α-phenyl-n- butyrate	77-8		178	42	270	-97	64 65	85-7		al 108 (cor),	

 $<sup>^{\</sup>bullet}\text{Derivative data given in order }\ m\ p$  , crystal color, solvent from which crystallized

					S	Saponifica	tion		T			
No	Name	Melting	Boiling point		Ac	ıd	Alco	hol	Amide	p- Toluidide	3,5-Dt- ntro-	Miscellaneous
		·c	°C	Equiv- alent	M P ,r °C	<b>ВР</b> , <b>°</b> C	MP,	BP, ℃	1	Toluidide	benzoate	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
115	Diphenyl carbonate	78	306	214			41 8, 42	182			145 8 (cor), al	Phenylhydrazine N,N'-diphenylcar- bazide, Tribromo deriv of phenol, 95
116	Methyl 3-nitrobenzoate	78	279	181	140		-97	64 65	143	162	108 (cor), al	
117 118	Ethyl 3-nitrocinnamate Isoeugenyl acetate	79 79	283	221 206	199 16 6	118 2	-117 3	78 32 267 5	196 82	153, 147	93, al 158 4 (cor ), BuOH	Dibromide, 132-3
119	Methyl 2-benzoyi- benzoate	79–80, 52	352	240	128 (anh), 91 (+1 H <sub>2</sub> O), w		-97	64 65	165 (cor), 162		108 (cor), al	
120	Benzyl oxalate	80		135	189 5 (anh ) 101 (+2 H <sub>2</sub> O)		-153	205 5	mono 219, di 419d	mono 169 di 268	113	
121	Methyl 4-bromobenzoate	81		215	251 3		-97	64 65	189 90, w		108 (cor), al	
122 123	Benzoin acetate Pentaerythritol tetra- acetate	83 84		254 76	16 6 16 6	118 2 118 2	133 262 253	344	82 82	153, 147 153, 147		
124	Pyrocatechol dibenzoate (Catechol dibenzoate)	84		159	122 4	249	105	245 6	130	158	dı 152	
125	Ethyl 3-hydroxy-2- naphthoate	85	291	216	222 3 (cor)		-1173	78 32	217 8 (cor), yel, al	221-3	93, al	
126	Diguaiacol carbonate (Di-(2-methoxyphenyl) carbonate, "Guaiacol carbonate")	87		274			32	205			141 2 (cor), al	Monobromo deriv , 178
127	Dimethyl <i>d l-</i> tartarate	90 (stab), 84 (meta- stab)	282	89	203 4 (+1 H <sub>2</sub> O), 205 6 (anh)		-97	64 65	226, w - me al		108 (cor ), al	
128	Di-2-tolyl oxalate (Di- "o-cresyl" oxalate)	91		135	189 5 (anh ), 101 (+2 H <sub>2</sub> O)		30 75	190 8	mono 219 di 419d	mono 169, di 268	138 4 (cor), al	
129	Ethyl 3,5-dinitroben- zoate	94, 93		240	204-5		-117 3	78 32	183		93, al	N-(β-Aminoethyl) morpholide, 189 5
130	2-Naphthyl salicylate	95 5, 93 5		264	158 3 subl at 76		123	285-6	142, 139	156	210 2, al	
131	Methyl 4-nitrobenzoate	96		181	241		-97	64 65	<b>*</b> 201, 198	204, 192	108 (cor),	
132	n-Propyi 4-hydroxy- benzoate	96		180	215, 210			97 1	162 (+1 H <sub>2</sub> O), w	203-4, al	al 123, pet eth	
133	1,2,4-Triacetoxybenzene ("Hydroquinone tri- acetate")	96-7		76	166	118 2	140 5		82	153, 147		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

					Sa	ponificat	ion					
No	Name	Melting point,	Boiling point		Acu	d	Alco	nol	Amide	<i>p</i> - Toluidide	3,5 Di- nitro-	Miscellaneous
NO	Manie	°C	°C	Equiv- alent	M P °C	BP, °C	МР, °C	B P °C	Aimac	Toluidide	benzoate	Miscenancous
134	Ethyl 3,5-dinitro- salicylate	99		256	182, 173 (+1 H <sub>2</sub> O)		-1173	78 32	181		93, al	
135	Dimethyl fumarate	101 7	193 25	72	286 7 (sealed tube), subl 200		-97	64 65	mono 270, 300 2 subl di 266d		108 (cor), al	n <sub>b</sub> <sup>10 5</sup> 1 40625, D <sup>110 5</sup> 1 0397
136 137	Ethyl 5-nitrosalicylate Dimethyl naphthalate	102 104		211 122	229 30 274	ļ.	-117 3 -97	78 32 64 65	225		93, al 108 (cor ), al	
138	Di-3-tolyl oxalate (Di- "m-cresyl" oxalate)	105		135	189 5 (anh), 101 (+2 H <sub>2</sub> O)		12	203	mono 219, di 419d	mono 169 di 268	164 5 (сог), al	
139	Phloroglucinol tri- acetate (1,3,5-Tri- acetoxybenzene)	105-6		76	16 6	118 2	200 9 (slow htng), 217 9 (rapid		82	153, 147	tri 162	
140	Diphenyl adipate	106		149	153-4 (cor)	21615	htng)		mono 125-30, w, di 220	241	145 8 (cor ), al	Tribromo deriv of phenol, 95
141	Acetylsalicylaldehyde diacetate ("Salicyl aldehyde triacetate")	107, 103		89	16 6	118 2			82	153, 147		Hydrolysis → sali- cylaldehyde, b p 197 (cor )
142	2-Naphthyl benzoate	107		248	122 4	249	123	285-6	130	158	210 2, al	
143	Methyl 3,5-dinitro- benzoate	108		226	204 5		-97	64 65	183		108 (cor),	
144	Dimethyl mesotartrate	111		89	140		-97	64 65	di 187, 189 90, dil me al		108 (cor), al	Bis-phenylhydrazide, 245
145	Di-4-tolyl carbonate (Di-"p-cresyl" carbonate)	114		242			36	202			188 6 (cor), al	
146	Ethyl oxamate	114 5		117	210	1103	-1173	78 32	419d	152 147	93, al	
147 148	Cholesteryl acetate Ethyl 4-hydroxybenzoate	114 116		416 166	16 6 215, 210	118 2	148 5 -117 3	78 32	82 162 (+1 H <sub>2</sub> O), w	153, 147 203-4, al	93, al	N-(β-Aminoethyl) morpholide, 184
149	Resorcinol dibenzoate	117		159	122 4	249	110 (stab), 108 8 5 (labile)	280 8 (cor)	130	158	bis 201	
150	Ethyl 3-nitrosalicylate	118		211	125 (+1 H <sub>2</sub> O)		-117 3	78 32	145		93, al	
151	Methyl 5-nitrosalicylate	119		197	229 30		-97	64 65	225		108 (сот ), al	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		<b>.</b>			S	aponificat	ion		1			
No	Name	Melting point,	Boiling point,	Equiv-	Acı	d	Alco	hol	Amide	p- Toluidide	3,5-Di- nitro	Miscellaneous
		·c	•c	alent	M P °C	B P °C	M.P., °C	B P °C		Totaldide	benzoate	
152	Diphenyl succinate	121		135	185 182 8	235d	41 8, 42	182, 183	mono 157, di 260d	mono 179 80, di 254 5 5 5, 260	148 5 (cor), al	Tribromo deriv of phenol, 95
153	Di-4-tolyl succinate (Di-"p-cresyl" succinate)	121		149	185 182 8	235d	36	202	mono 157, di 260d	mono 179 80, di 254 5- 5 5, 260	188 6 (cor ), al	
154 155	Hydroquinone diacetate Methyl 3-nitro- cinnamate	124 124		97 207	16 6 199	118 2	171 -97	286 64 65	82 196	153, 147	bis 317 108 (cor),	
156	Methyl 3,5-dinitro- salicylate	127		242	182		-97	64 65	181, 173 (+1 H <sub>2</sub> O)		al 108 (cor ), al	
157	Methyl 4-hydroxy- benzoate	131		152	215, 210		~97	64 65	162 (+1 H <sub>2</sub> O), w	203-4, al	108 (cor),	
158	Methyl 3-nitro- salicylate	132		197	125 (+1 H <sub>2</sub> O)		- 97	64 65	145		108 (cor),	
159	Triethyl trimesate	133		98	380 (cor )		~1173	78 32	tri 365d (cor)		93, al	
160	Ethyl 4-nitro- cinnamate	137, 142		221	285		-117 3	78 32	204, 217		93, al	
161	Dimethyl terephthalate	141		97	300 (subl without melting)		-97	64 65	di >225		108 (cor), al	
162	Tetramethyl pyromellitate	142	·	77.5	275		-97	64 65			108 (cor), al	
163	Trimethyl trimesate	144		84	380 (cor )		-97	64 65	tri 365d (cof)		108 (cor), al	
164	Di-4-tolyl oxalate (Di- "p-cresyl" oxalate)	148-9		135	189 5 (anh ), 101 (+2 H <sub>2</sub> O)		36	202	mono 219, di 419d	mono 169, di 268	188 6 (cor), al	
165	Methyl 4-nitro- cinnamate	161		207	285		-97	64 65	204, 217		108 (cor), al	
166	Diethyl mucate	163-4		133	214d , 223-55		-1173	78 32	mono 192d , di 220		93, al	
167 168	Pyrogaliol triacetate Dimethyl mucate	165, 172 165 7d		84 119	16 6 214d , 223-55	118 2	133 -97	309 64 65,	82 mono 192d, di 220	153, 147	tri 205 108 (cor), al	
169	Methyl gallate	200–1		184	253-4d , 222 40d		-97	64 65	189		108 (cor), al	
170	Hydroquinone di- benzoate	204 (cor), 199		159	122 4	249	171, 172	286	130	158	bis 317	

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE XVII**

p-Toluenesulfonamide (p-Toluenesulfonyl derivative).\*

From the amino acid in aqueous sodium hydroxide with p-toluenesulfonyl chloride in ether.

For directions and examples see: Cheronis, pp. 453-454; Linstead, pp. 77-78; Shriner, p. 231; Vogel, p. 437; Wild, pp. 169-170; E. Fischer and P. Bergell, Chem. Ber., 35, 3779, 3784 (1902); E. W. McChesney and W. K. Swann, J. Amer. Chem. Soc., 59, 1116 (1937).

From the amino acid in aqueous sodium hydroxide with p-toluenesulfonyl chloride.

See: J. I. Harris and T. S. Work, Biochem. J., 46, 582 (1950).

From the amino acid with p-toluenesulfonyl chloride and triethylamine in aqueous tetrahydrofuran.

See: D. Theodoropoulos and L. C. Craig, J. Org. Chem., 21, 1376 (1956).

For an extensive list of references for the preparation of the p-toluenesulfonyl derivatives of amino acids see: J. P. Greenstein and M. Winitz, Chemistry of the Amino Acids, Vol. 2, John Wiley and Sons, New York, 1961, pp. 886-889.

#### 3,5-Dinitrobenzamide (3,5-Dinitrobenzoyl derivative).\*

$$H_2NCHRCOOH + VO_2$$
 $NO_2$ 
 $NO_2$ 
 $NO_2$ 
 $NO_2$ 
 $NO_2$ 
 $NO_2$ 

3,5-Dinitrobenzamide

From the amino acid in aqueous sodium hydroxide with 3,5-dinitrobenzoyl chloride.

For directions and examples see: Cheronis, p. 453; Vogel, p. 436; Wild, p. 168; B. C. Saunders, Biochem. J., 28, 580 (1934); J. Chem. Soc., 1397 (1938); B. C. Saunders, G. J. Stacey and I. G. E. Wilding, Biochem. J., 36, 368 (1942); B. W. Town, Biochem. J., 35, 578 (1941).

Benzamide (Benzoyl derivative).

$$H_2NCHRCOOH + C_6H_5COCI \rightarrow C_6H_5CONHCHRCOOH + HCI$$

Benzamide

From the amino acid in aqueous sodium carbonate or bicarbonate and benzoyl chloride.

For directions and examples see: Linstead, p. 77; Vogel, p. 436; Wild, p. 167.

From the amino acid in aqueous sodium hydroxide with benzoyl chloride.

See: Cheronis, p. 453; E. Fischer and P. Bergell, Chem. Ber., 35, 3779, 3784 (1902); 39, 597 (1906).

Acetamide (Acetyl derivative).

From the amino acid with acetic anhydride in water.

For directions and examples see: Linstead, p. 77; Shriner, p. 226; Wild, p. 167; R. M. Herbst and D. Shemin in Organic Syntheses, Coll. Vol. 2, (Ed. A. H. Blatt), John Wiley and Sons, New York, 1943, p. 11.

From the amino acid in aqueous sodium hydroxide with acetic anhydride.

See: Cheronis, p. 454; M. Bergmann and L. Zervas, Biochem. Z., 203, 288 (1928).

Carbobenzoxamide (Carbobenzoxy derivative; Benzyloxycarbonyl derivative).

Carbobenzoxamide

From the amino acid in aqueous sodium hydroxide with carbobenzoxy chloride (benzyl chloroformate). For directions and examples see: M. Bergmann and L. Zervas, Chem. Ber., 65, 1192 (1932); M. Winitz, L. Bloch-Frankenthal, N. Izumiya, S. M. Birnbaum, C. G. Baker and J. P. Greenstein, J. Amer. Chem. Soc., 78, 2423 (1956).

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

### EXPLANATIONS AND REFERENCES TO TABLE XVII (Continued)

For an extensive list of references for the preparation of the carbobenzoxy derivatives of amino acids see: J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 887-895.

Phenylurethane (Phenylurea derivative).\*

From the amino acid with aqueous potassium hydroxide and phenylisocyanate. For directions and examples see: Linstead, p. 78; Shriner, p. 211; Wild, p. 171.

Phenylhydantoin.\*

From the phenylurethane (obtained as described above) in aqueous hydrochloric acid. For directions and examples see: Cheronis, p. 456.

Rf Values.

For the determination of the Rf values of amino acids in aqueous phenol, in collidine-lutidine and in butanol-acetic acid mixtures see: R. J. Block, R. LeStrange and G. Zweig, Paper Chromatography, Academic Press, New York, 1952, pp. 51-66; E. Lederer and M. Lederer, Chromatography, Elsevier Publishing Co., New York, 1957, pp. 306-311.

NOTE: For additional information regarding directions and examples for the preparation of derivatives of amino acids which are similar to those of amines (e.g., phenylurethane, acetamide, etc.) see explanations and references to Table XVIII, p. 291, 292, 293, 294.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

		Decomp	S	pecific i	otation		Rí values**	•	p	Phenyl		3.5		
No	Name	temp °C	[α] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid	Toluene- sulfonyl	urea	Benzoyl	Dinitro benzoyl	Picrate	Miscellaneous
1	3-Aminohydro- cinnamic acid	84-5												Acetyl, 162, Hydrochlo- ride, 191
3	N-Methyl-β- alanine Aminomalonic acid	99 100 109									61, pet eth			Hydrochloride, 105, aq al Formyl, 48, Heat → gly- cine decom temp 228 30 262
4	2-Aminophenyl- acetic acid 2-Amino-1-	119									179, al			Acetyl, 158, Formyl, 110
	Naphthoic acid N-Phenyl-	127								195	63			N-Acetyl, 195-6, al Acetyl 124
7	glycine 4-Aminohydro- cinnamic acid	132									194-5			Acetyl 143 (anh ) 124
8	L-Ornithine	140	11 5	25	c = 65	0 79	0 11	0 15		190	240 (mono), 189 (di)		208	(hyd) α,δ-Dicarbobenzyloxy, 112 4
9	Anthranilic acid (2 Amino benzoic acid)	147				0 85			217	181	182	278	104	
10	3-Aminophenyl- acetic acid	151												Amide, 164 6, al Chloro- acetyl 187-8, al
11	5-Amino- pentanoic acid (ω-Amino-n- valeric acid)	157									105 94			aı
12	2-Aminocin- namic acid	158, yel									191 3, al			Monoacetyl, 250 I, al , Diacetyl 158, Igr
13	DL-β-Amino-n- valeric acid DL-3-Amino pentanoic	160 5									145 6			N-β Naphthal- enesulfonyl 134
14	acid) 2-Amino-4- toluic acid	165											l I	Acetyl, 279-81
15	1	174				0 86				270 264	248	270		
16	trans-4-Amino-	175-6								204	274			Acetyl, 259 60
17	ω-Aminotrı- decylic acid	177									111 105			Benzenesul- fonyl, 120, al
18	3-Amino-4- toluic acid (Homoanthra- nilic acid)	177							;					Amide, 146, Acetyl, 184, Formyl, 186, al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

<sup>\*\*</sup> Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup>Aqueous phenol 80°, w/w for basic amino acids 3 vol — a, of a conc aq NH, has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml.), 2,4,6-collidine (100 ml.), water (100 ml.), diethylamine (3 ml.), Butanol-acetic acid-water 40 ml. 10 ml. 10 ml.

		Decomp	S	pecific i	rotation		Rf values**	•	p-	Dherry		3 5-		
No	Name	temp °C	[α] <sub>D</sub>	т °С	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid	p- Toluene- sulfonyl	Phenyl urea	Benzoyl	Dinitro benzoyl	Picrate	Miscellaneous
19 20	4-Amino-1- naphthoic acid trans- 3-Amino-	177 181, yel									229			Acetyl, 189, Amide, 175 Acetyl, 237, al
21	3-Amino-1-	181	<u> </u> 											Acetyl, 254 5
22	naphthoic acid N-Ethylglycine	182												Hydrochloride,
23 24	L-Canavanine L-Glutamine	184 185	7 9	20		0 51 0 6					tri 186		163 4	Carbo- benzyloxy,
25	Hippuric acid	187												137 4 Nitrobenzyl ester 136 4- Bromo phenacyl ester, 151
26	4-Aminobenzoic acid	188				0 81				300	278	290		
27	DL-Canaline	190-5						0 43			158 60 (d1)			γ-Carboben- zyloxy, 208-10
20	Betaine (Tri- methyl- glycine)	193						0 43				:	:	Formyl, 183
29	DL-β-Amino- butyric acid	194				0 78					154			
30	DL-Glutamic acid	199				0 31	0 20	0 3	117		153 155			Acetyl, 187
31	4-Aminophenyl- acetic acid	199 200									205-6, al			Acetyl, 168 70, Chloroacetyl, 158-60
32	eta-Alanine	200				0 66	0 22	0 37		168	120	202		Carboben- zyloxy, 106
33 34	L-Isoserine ω-Amino-n- caproic acid (6-Amino- hexanoic acid)	200 202				0 39					107-9 45-7			
35	$\gamma$ -Aminobutyric acid	203				0 75					:			Hydrochloride, 135 Heat → pyrrolidone,
36	DL-Proline	203 (mono- hyd) 191				0 88	0 28	0 43		170		217	135-7	24, pet eth
37	γ-Amino-n- caproic acid (4-Amino- hexanoic acid)	205-7									150 2			Hydrochloride, 120 1
38		205-6 205 r h											•	Acetyl, 170 2, 252-3 Heating with conc HCl → 1-naphthyl- amine, 50

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

<sup>\*\*</sup>Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup> Aqueous phenol 80% w/w, for basic amino acids 3 vol —% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained, Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

		Decomp	S	pecific r	otation	1	Rf values**	•	p	Phenyl		3,5		
No	Name	temp °C	[α] <sub>D</sub>	τ °C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid	Toluene sulfonyl	urea	Benzoyl	Dinitro benzoyi	Picrate	Miscellaneous
40	L-Arginine	207	11 8	20 20	c = 0 87 in 0 5 N-NaOH c = 3 48 in water	0 89	0 17	0 2			298 (mono), 235 (di)	150	217 (mono), 190 (di)	Monocarbo- benzyloxy, 175
41	L-Glutamic acid	211 r h , 197 s h	31 2 11 5	22 4 18	c = 1 0 in 6N-HCl c = 1 47 in water	0 31	0 2	0 3	131		(***)			Acetyl, 199, Carboben- zyloxy, 120
42	5-Amino-1- naphthoic acid	212							1					Acetyl, 296, al
43 44	Sarcosine L-3,5-Di-iodo- tyrosine	212 213	2 9	20	c = 5 08 in	0 78 0 61	0 55			102	104	153		Acetyl, 135
45	L-α-Asparagine	213-5			Triv-nei	0 47								Carboben- zyloxy, 164
46	DL-γ-Amino-n- valeric acid (DL-4-Amino- pentanoic acid)	214 (cor)									132			
47	,	214	ļ		}	0 77	ļ				99 (dı)		192 3	
	β-Aminoiso- valeric acid	217				<u> </u>	i			102	1.52			Hydrochloride,
49	$\beta$ -Hydroxy- valine	218							1	182	153 (mono)			2-Naphthalene- sulfonyl, 261
50	L-Proline	220 2	-93 0 -52 6	20	c = 242  in 0 6 N-KOH c = 057  in	0 88	0 28	0 43	130-3				154	Phenylhy- dantoin, 144
51	L-Citrulline	222	3 7	20	0 5 N-HCl c = 2 in	0 63	0 23	0 25					206	
52	7-Amino-1- naphthoic acid	223-4			water									Acetyl, 229
53	-	224	14 6	20	c = 65 in water	0 81	0 11	0 14		184	235 (mono), 149 (di)		266	Monohydro- chloride 235 Dihydrochlo-
			25 9	22 9	c = 20 in 6 N-HCl									ride, 193 α,ε- Dicarboben- zyloxy, 150
54	β-L-Asparagine	227				0 40	0 21	0 19	175	164	189	196	180	Carboben- zyloxy, 165
55	3,5-Diamino- benzoic acid	228					į							3,5-Diacetyl, 184, Et ester, 84
56	L-Serine	228	14 45	25	c = 9 34 in 1 N-HCl	0 36	0 28	0 27						Carboben- zyloxy, 121
			-6 83	20	c = 104 in water				Ì					
57	Glycine	228 30, 262			Water	0 41	0 24	0 26	147	197	187 5	179	202	Carboben- zyloxy, 120
58	DL-Thyroxine	230 s h , 250				0 86	0 76				210 5			N-Chloro- acetyl, 201,
59	DL-β-Hydroxy- norvaline	230								156	170			Me ester 156 Phenylhy- dantoin, 154 5

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

<sup>\*\*</sup> Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup>Aqueous phenol 80% w/w, for basic amino acids 3 vol —% of a conc aq NH, has to be present (in a separate vessel) in the chamber, otherwise low values are obtained, Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml

		Decomp	S	pecific i	rotation	1	Rf values**	•	p	Phenyl	_	3,5-	_	
No	Name	temp, °C	[α] <sub>D</sub>	т, °с	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid	Toluene sulfonyl	urea	Benzoyl	Dinitro- benzoyl	Picrate	Miscellaneous
60	DL-β-Amino- hydrocinnamic acid	231									194 6			Hydrochloride, 218, Formyl, 128-9, Acetyl, 161, al
61	DL-Homo- aspartic acid (α-Amino-α- methyl suc- cinic acid)	232												Amide, 266
62	,	234-5	7 0	20	water									N-Formyl, 142-3
63	L-β-Amino- hydrocinnamic acid	234-5	_7 <b>5</b>	25	water									N-Formyl, 142 3
64	3-Amino- salicylic acid	235									189		7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	Acetyl, 215, N- Benzenesul- fonyl, 194
65	DL-Allo- threonine	237				0 50	0 34				176 (mono), 174 (di)			
66	DL-Arginine	238				0 89	0 17	0 2			230 (di, anh), 176 (di, hyd)		200 (mono), 196 (dı)	
67	4-Dimethyl- aminobenzoic acid	242												Amide, 206, Anilide, 182-3
68	β-Amino-β- phenyliso- butyric acid	243									205			
69	DL-Isoserine	246				0 39				184	151			Phenylure- thane, 183-4
70	DL-Serine	246				0 36	0 28	0 27	213	169	149-50			Carboben- zyloxy, 125
71	4-Hydroxy- phenylglycine	248									117			Monoacetyl, 203, Diacetyl, 174 5, Amide, 135
72	Isoaspartic acid (α-Amino-α- methylmalonic acid)	250									·			Diamide, 200 1 Heat → ala- nine, 295 d
73	DL-Threonine	251				0 50	0 34	0 35			177 8	145		Phenylhydan- toin, 164
74	DL-α-Amino- phenylacetic acid	256 (subl )									175, al			Acetyl, 198 5, Formyl, 180
75	L-Cystine	260	-214 4 -70 0		c = 10 in 102 N-HCl c = 04 in 02			0 1	204 5	160	181 (dı)	180		Dicarboben- zyloxy, 123
76	DL-α-Amino- hydratropic acid (DL-α- Phenyl- alanne)	260 (subl )			N-NaOH									N-Carbo- ethoxy, 191, al

<sup>•</sup> Derivative data given in order mp, crystal color, solvent from which crystallized

<sup>\*\*</sup> Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup>Aqueous phenol 80%, w/w for basic amino acids 3 vol —% of a conc aq NH, has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml). Butanol-acetic acid-water 40 ml 10 ml 10 ml

		Decomp		Specific	rotation		Rf values**	•	ρ-	Phenyl		3,5		
No	Name	temp , °C	[α] <sub>D</sub>	т °с	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol Ac acid	Toluene- sulfonyl	urea	Benzoyl	Dinitro benzoyl	Picrate	Miscellaneous
77	Glycylglycine	260				0 39		0 22	178	176	208	210		Carboben- zyloxy, 178
78	DL-β-Phenyl- alanine	264				0 85	0 48	0 68	134 5	182	188		173	Carboben zyloxy, 103
79	DL-Aspartic acid	270 (>300)				0 19	0 21	0 24			119 (hyd), 176 (anh)			Carboben- zyloxy, 116
80	DL-α-Amino- octanoic acid	270				0 89	0 55		<u></u>		128			
81	L-Aspartic acid	270	24 6	24	c = 20 in 6 N HCl	0 19	0 21	0 24	140	162	185			Carboben- zyloxy, 116
82	DL-α-Amino- nonanoic acid	273									128			
83	L-Hydroxy- proline	274	-47 3 -75 2	20 22 5	c = 1 31 in 1 N-HCl c = 1 0 in	0 63	0 28		153	175	100 (mono), 92 (di)			
84	DL-Trypto- phane	275			water	0 75	0 50	0 50	176			240		N-Benzenesul- fonyl 185 Carboben zyloxy, 169-70
85	α-Aminoiso- butyric acıd	280				0 74	0 32				198			1-Naphthyl- urea, 198
86	DL-α-Amino- heptanoic acid	281	į 						}		135			
87	DL-Methionine	281				0 81	0 42	0 55	105		145			Acetyl, 114, Formyl, 100, Carboben- zyloxy, 112
88	5-Ammosalicy- lic acid	283									252			Monoacetyl, 218 Diacetyl, 184
89	DL-Lanthionine	283				0 26	011				195 8 (di)			
90	L-Methionine	283	-811	25	c = 081n water	0 81	0 42	0 55				94 5 (hyd), 150 (anh)		Acetyl, 98 9 1-Naphthyl- urea, 188
91	L-(+)-lso- leucine		40 6	20	c = 5 l in 6 l N-HCl	0 84	0 45	0 72	130-2	121	117	(4)		Formyl, 156
			11 29	20	c = 3 1 in water									
	L-Phenylala- nine	283 320	-35 1	20	c = 1 94 in water	0 85	0 48	0 68	164	181	146	93		Carboben- zyloxy, 126 8
93	L-Hexahydro- tyrosine	285												N-4-Nitro- benzoyl, 225
1	D-( - )-lso- leucine	285	-40 86	20	6 I N-HCI	ì		0 72			117			Formyl, 156
95	L-Histidine	288, 253	13 0 -39 0	22 7	c = 15 in 6 N-HCl c = 113 in	0 69	0 27	0 2	202 4	į	230 (mono)	189	86	Carboben- zyloxy, 209
96	L-Cysteic acid	289 260	8 66		water c = 1 85 g in 25 ml water					į				Diphenylacyl ester, 203

 $<sup>{}^{</sup>ullet}$  Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

<sup>\*\*</sup> Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup>Aqueous phenol 80°, w/w for basic amino acids 3 vol —°/, of a conc aq NH, has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml.), 2,4,6-collidine (100 ml.), water (100 ml.), diethylamine (3 ml.) Butanol-acetic acid-water 40 ml. 10 ml. 10 ml.

$\neg$		Decomp	Sş	ecifc r	otation	1	Rí values**	•	р-	Phenyl		3 5-		
No	Name	temp,	[α] <sub>D</sub>	T, *C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol Ac acid	Toluene sulfonyl	urea	Benzoyl	Dinitro- benzoyl	Picrate	Miscellaneous
97	L-Tryptophane	290 252	-31 5 6 17	22 7 20	c = 1 0 in water c = 2 42 in 0 5 N- NaOH	0 75	0 50	0 5	176	166	183	233		Carboben- zyloxy 126
98	DL-N-Methyl- α-alanine	292			NaOn									Methylamide, 43, Hydro- chloride, 110
99	DL-Isoleucine	292, 275 s h				0 84	0 45	0 72	141	120	118			Formyl, 121
100	L-(+)-α- Aminobutyric acid	292, 303 s h	18 65	19	c = 481n 6 N-HCl	0 71	0 31	0 45			121			Formyl, 126, 1-Naphthyl- urea, 195
101 102	DL-Leucine DL-α-Amino-	293, s h 332 295,				0 84	0 45	0 73		165	137 41	187		I-Naphthyl-
	α-methyl- valeric acid (DL-α-Amino- α-methyl pentanoic acid)	s h		Ē										urea 196
103		295				0 60	0 28	0 38	139		166	177		Carboben- zyloxy, 114 5
104	D-α-Amino- hydratropic acid	295 (subl )	70 0	18	water									Formyl 194 5
105	L-Alanine	297	14 7 2 7	15 22	c = 5 8 in 0 97 N-HCl c = 10 3 in	0 60	0 28	0 38	133		151			Carbobenzyl oxy, 84 1- Naphthyl-
106	DL-Norleucine	297 327			water	0 84	0 45	0 74	124					urea, 220 2 Formyl, 114
107	DL-Valine	298, s h , 282				0 78	0 36	0 6	110	164	132	158		
108	L-Djenkolic acid	300-50	-60 5 -47 5	20 5 25	1% in 1N-HCl 2% in 1N-HCl	0 40	0 13				166 (mono). 88 (d1)			
109	$\alpha$ -alanine	300 300-5	5 6	20	water	0 42								Hydrochloride, 165 6 N-Me, 241,
111	L-(+)- Norleucine	301	21 3 6 26	20 20	c = 4 25 in 6 N-HCl c = 0 7 in water	0 84	0 45	0 74			53			N-Et, 147 Formyl, 115-6, 2-Naph- thalenesul- fonyl, 149
112	DL-Norvaline	303, s h			watel	0 80	0 39	0 65		117				Formyl, 132, Phenylhy- dantoin, 103
113	Methylguan-	303		-									218 20	Diacetyl, 165
114	doacetic acid) 4-Aminocyclo- hexanecar- boxylic acid	303-4												Heat → lactam, 191-2

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

<sup>\*\*</sup>Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup>Aqueous phenol 80°, w/w for basic amino acids 3 vol — o, of a cone aq NH, has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml) Butanol-acetic acid-water 40 ml 10 ml 10 ml

		Decomp	s	pecific	rotation	<u> </u>	Rf values**	•	P	Phenyl		3 5		
No	Name	temp °C	[α] <sub>D</sub>	т •с	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol Ac acid	Toluene sulfonyl	urea	Benzoyl	Dinitro benzoyl	Picrate	Miscellaneous
115	DL-α-Amino- butyric acid	304				0 71	0 31	0 45		170	147			1-Naphthyl- urea, 194, Phthalyl, 96
116	meso-Lan- thionine	304				0 26	011		i i		198 200			Dicarbo- benzyloxy, 139-40
117	Creatinine	305, 260									 		220	
118	L-α-Amino- phenylacetic acid	305 10	-111 0, -157	20, 20	water dil HCl									Acetyl 191, Formyl 190
119	meso-2,3-Di- aminosuccinic acid	306					!				:	(d1) 212 hyd		Diacetyl, 235
120	L-(+)-Norva- , line	307	23 0	20	c = 10 in 10% HCl	0 80	0 39		ļ		64			Acetyl, 137
121	LaTyrosine	314-8 r h 290 5 s h	-8 64 -13 2	20 18	c = 44 in 63 N HCl c = 091 in 3 N-NaOH	0 51	0 51	0 45	N- 188	104	N- 166 7,211 2(d1)			N-Acetyl, 148, Diacetyl, 172, N-Carboben- zyloxy, 101
122	L-(+)-Valine	315	28 8	20	c = 34 in 6 N-HCl	0 78	0 36	0 60	147		127	157 8		Carboben- zyloxy, 64-5
123	L-Leucine	337	15 I -10 8	25 9 24 7	,	0 84	0 45	0 73	124	115	118	187		
124	DL-Tyrosine	340 r h , 295 s h			water	0 51	0 51	0 45	224 6		N- 197	252 4 (d1)		
125	1-Aminocyclo- hexanecar- boxylic acid	350, 320 s h											209-10	Hydrochloride, 310
126	-										164 ( <i>dı</i> ) hyd			Diacetyl, 235
127	DL-Ornithine					0 79	011	0 15	188 (mono)	192	4 N 285-8, 188 (di)		208 (dı)	
128	L-(+)-Alloiso- leucine		38 1	20	c = 3 97 in 6 N-HCl					151				Formyl, 126, 1- Naphthylurea, 166, Benzene- sulfonyl, 147
129	DL-Lysine					081	011	0 14		196	249 (mono); 146 (di)		225 (mono)	Monohydro-
130	L-Cysteine					0 57								S-Benzyl, 216, Oxid $\rightarrow$ L- cystine, 260 d Hydrochlo- ride, 175-8, $[\alpha]_D^{25}$ 9 5 (c = 2 in water)

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

<sup>\*\*</sup>Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

<sup>\*\*\*</sup>Aqueous phenol 80°, w/w for basic amino acids 3 vol — on of a cone aq NH, has to be present (in a separate vessel) in the chamber otherwise low values are obtained. Collidine-lutidine mixture. 2.6-lutidine (100 ml.). 2.4 6-collidine (100 ml.), water (100 ml.) diethylamine (3 ml.). Butanol-acetic acid-water. 40 ml. 10 ml. 10 ml.

#### **EXPLANATIONS AND REFERENCES TO TABLE XVIII**

Acetamide (Acetyl derivative) \*

$$RNH_2 + (CH_3CO)_2O \rightarrow CH_3CONHR + CH_3COOH$$
  
 $RR'NH + (CH_3CO)_2O \rightarrow CH_3CONRR' + CH_3COOH$ 

Acetamide

For primary and secondary amines only

From the amine with acetic anhydride without solvent

For directions and examples see Cheronis, pp 591 593, Linstead, p 60, Vogel, p 652, Wild, p 218, J J Sudborough, J Chem Soc, 79, 533 (1901), L C Raiford, R Taft and H P Lankelma, J Amer Chem Soc, 46, 2051 (1924)

From the amine with acetic anhydride in aqueous sodium hydroxide

See F D Chattaway, J Chem Soc, 2495 (1931)

From the amine with acetic anhydride in pyridine

See Cheronis, pp 590, 592 593

From the amine hydrochloride with acetic anhydride in aqueous sodium acetate

See Linstead, p 60, Vogel, p 652

From the amine with acetic anhydride in water

See Shriner, p 226

From the amine with acetic anhydride in acetic acid

See Wild, p 218

Benzamide (Benzoyl derivative) \*

$$RNH_2 + C_6H_5COCI \rightarrow C_6H_5CONHR + HCI$$
  
 $RR'NH + C_6H_5COCI \rightarrow C_6H_5CONRR' + HCI$   
Benzamide

For primary and secondary amines only

From the amine with benzoyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 591, 593-594, Linstead, p 60, Vogel, p 652, Wild, p 219

From the amine with benzoyl chloride in a pyridine-benzene mixture

See Shriner, p 226

From the amine with benzoyl chloride in benzene

See Shriner, p 227

From the amine with benzoyl chloride in an aqueous sodium hydroxide-chloroform mixture

See Shriner, p 226

From the amine with benzoyl chloride

See Vogel, p 653

Benzenesulfonamide (Benzenesulfonyl chloride derivative) \*

$$RNH_2 + C_6H_5SO_2CI \rightarrow C_6H_5SO_2NHR + HCI$$
  
 $RR'NH + C_6H_5SO_2CI \rightarrow C_6H_5SO_2NRR' + HCI$ 

Benzenesulfonamide

For primary and secondary amines only

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 595 596, Shriner, pp 103-104, Vogel, p 653, O Hinsberg, Chem Ber, 23, 2962 (1890), 38, 906 (1905)

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in methanol

See Cheronis, p 596

From the amine with benzenesulfonyl chloride in benzene

See Wild, p 221

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in acetone

See Wild, p 221

From the amine with benzenesulfonyl chloride in aqueous pyridine

See Wild, p 221

From the amine with benzenesulfonyl chloride in pyridine

See Vogel, p 653

#### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide See Wild, p 221

p-Toluenesulfonamide (p-Toluenesulfonyl chloride derivative) \*

$$RNH_2 + CH_3$$
  $\longrightarrow$   $SO_2CI \rightarrow CH_3$   $\longrightarrow$   $SO_2NHR + HCI$ 

$$RR'NH + CH_3$$
  $\longrightarrow$   $SO_2CI \rightarrow CH_3$   $\longrightarrow$   $SO_2NRR' + HCI$ 

$$\rho\text{-Toluenesulfonamide}$$

For primary and secondary amines only

From the amine with p-toluenesulfonyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, p 595, Linstead, p 60, Shriner, pp 103 104, Vogel, p 653

From the amine with p-toluenesulfonyl chloride in benzene

See Wild, p 221

From the amine with p-toluenesulfonyl chloride in acetone

See Wild, p 221

From the amine with p-toluenesulfonyl chloride in pyridine

See F Bell, J Chem Soc, 2787 (1929)

From the amine with p-toluenesulfonyl chloride in aqueous pyridine

See Wild, p 221

Phenylthiourea \*

$$RNH_2$$
 +  $C_6H_5N=C=S$   $\rightarrow$   $C_6H_5NHCSNHR$   
 $RR'NH$  +  $C_6H_5N=C=S$   $\rightarrow$   $C_6H_5NHCSNRR'$   
Phenylthiourea

For primary and secondary amines only

From the amine with phenylisothiocyanate in alcohol

For directions and examples see Cheronis, pp 599-600, Shriner, p 227, Vogel, p 422, Wild, p 227, T Otterbacher and F C Whitmore, J Amer Chem Soc, 51, 1909 (1929)

From the amine with phenylisothiocyanate without solvent

See Vogel, p 422, Wild, p 227, N A Lange, H L Ebert and L K Youse, J Amer Chem Soc, 51, 1911 (1929)

1-Naphthylthiourea \*

For primary and secondary amines only

From the amine with 1-naphthylisothiocyanate in ethanol

For directions and examples see Cheronis, pp 600-601, Vogel, p 422, Wild, p 227, C M Suter and E W Moffet, J Amer Chem Soc, 55, 2497 (1933)

From the amine with 1-naphthylisothiocyanate without solvent

See Vogel, p 422, Wild, p 227, C M Suter and E W Moffett, J Amer Chem Soc, 55, 2497 (1933)

Phenylurea

$$RNH_2 + C_6H_5N=C=O \rightarrow C_6H_5NHCONHR$$
  
 $RR'NH + C_6H_5N=C=O \rightarrow C_6H_5NHCONRR'$ 

Phenylurea

For primary and secondary amines only

From the amine with phenylisocyanate in petrol ether

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### **EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)**

For directions and examples see Linstead, p. 61, Wild, pp. 223-224

From the amine with phenylisocyanate without solvent

See N A Lange, H L Ebert and L K Youse, J Amer Chem Soc, 51, 1911 (1929)

1-Naphthylurea \*

$$RNH_2 + 1-C_{10}H_7N = C = 0 \rightarrow 1-C_{10}H_7NHCONHR$$
  
 $RR'NH + 1-C_{10}H_7N = C = 0 \rightarrow 1-C_{10}H_7NHCONRR'$ 

1 Naphthylurea

For primary and secondary amines only

From the amine with 1-naphthylisocyanate without solvent

For directions and examples see Cheronis, p 599, H E French and A F Wirtel, J Amer Chem Soc, 48, 1736 (1926)

From the amine with 1-naphthylisocyanate in petrol ether

See Linstead, p 61, Wild, pp 223 224

From the amine with 1-naphthylisocyanate with water

See Wild, p 224

Picrate \*

$$RNH_2 + O_2N$$
 $OH \rightarrow RNH_2 \cdot O_2N$ 
 $OH \rightarrow NO_2$ 
 $OH \rightarrow NO_2$ 
 $OH \rightarrow NO_2$ 
 $OH \rightarrow NO_2$ 

(Molecular complex)

For primary, secondary and tertiary amines

From the amine with picric acid in methanol or in ethanol

For directions and examples see Cheronis, pp 603 604, Linstead, p 50, 61, Shriner, p 229, Vogel, pp 422-423, Wild, p 212

From the amine with picric acid in water

See Vogel, p 422

From the amine with picric acid in acetone or benzene

See Wild, p 212

From the amine with picric acid

See Shriner, p 229

#### 3,5-Dinitrobenzoic acid salt \*

$$R_3N + NO_2$$

$$NO_2 \qquad NO_2$$

$$NO_2 \qquad NO_2$$

$$NO_2 \qquad NO_2$$

Trialkylammonium 3,5-dinitrobenzoate

Especially for tertiary amines

From the amine with 3,5-dinitrobenzoic acid in methanol or ethanol

For directions and examples see Cheronis, pp 602 603, Wild, p 215, C A Buehler, E J Currier and R Lawrence, Ind Eng Chem, Anal Ed, 5, 277 (1933), C A Buehler and J D Calfree, Ind Eng Chem, Anal Ed, 6, 351 (1934)

β-Resorcylic acid salt

OH

OH

$$R_3N + HO$$

COOH  $\rightarrow HO$ 

COO<sup>-</sup>  $R_3NH^+$ 
 $\beta$ -Resorcylic acid

Trialkylammonium resorcylate

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

Especially for tertiary amines.

From the amine with  $\beta$ -resorcylic acid in ether.

For directions and examples see: Cheronis, p. 603; K. W. Wilson, F. E. Anderson and R. W. Donohoe, Anal. Chem., 23, 1032 (1951).

Chloroplatinic acid salt.\*

$$R_3N + H_2PtCl_6 \rightarrow [R_3NH]_2^+PtCl_6^=$$
Chloroplatinate

Especially for tertiary amines.

From the amine in aqueous hydrochloric acid with aqueous chloroplatinic acid.

For directions and examples see: Shriner, p. 230; Wild, p. 213.

Hydrochloride.

For primary, secondary and tertiary amines.

From the amine with gaseous hydrogen chloride in ether, benzene or chloroform.

For directions and examples see: Cheronis, p. 601; Shriner, p. 224; Wild, p. 211.

From the amine with dilute aqueous hydrochloric acid.

See: Wild, p. 211.

Methiodide.\*

$$R_3N + CH_3I \rightarrow [R_3NCH_3^+]I^-$$
Methodide

Especially for tertiary amines.

From the amine with methyl iodide without solvent.

For directions and examples see: Linstead, p. 61; Shriner, p. 228; Vogel, p. 660; Wild, p. 232.

From the amine with methyl iodide in isopropyl ether.

See: Cheronis, p. 604.

From the amine with methyl iodide in ether or benzene.

See: Vogel, p. 660.

Metho-p-toluenesulfonate (Methyl p-toluenesulfonate).\*

$$R_3N + CH_3$$
  $\longrightarrow$   $SO_3CH_3 \rightarrow CH_3$   $\longrightarrow$   $SO_3^- [R_3NCH_3]^+$  Metho-p-toluenesulfonate

Especially for tertiary amines.

From the amine with methyl p-toluenesulfonate in isopropyl ether.

For directions and examples see: Cheronis, p. 604.

From the amine with methyl p-toluenesulfonate in benzene.

See: Linstead, p. 62; Shriner, p. 229; Vogel, p. 660; Wild, p. 233; C. S. Marvell, E. W. Scott and K. L. Amstutz, J. Amer. Chem. Soc., 51, 3638 (1929).

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

						<del></del>	т	<del></del>	r		<del>,                                    </del>	
No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
1	Methylamine	-6			0 699-11	28	80	30	75	113	207, 215	
2	Dimethylamine	7			0 68043	1	41	47	79	135	158	
3	Ethylamine	16 5			0 7057	ľ	71	58	63	106	165	
- 1	,	19	}		1	1		1		135	}	
4	Isopropylamine	33		1 37715	0 6914*			26		101		1-Naphthylurea, 200, 1-Naphthylthiourea, 143
5	Ethyl methyl amine	36									196	Chloroplatinate, 207, Hydrochloride, 126–
6	tert-Butylamine	46		1 379418	0 700415	101 2	134			120	198	Hydrochloride, 270– 80
7	n-Propylamine .	49		1 390117	0 71425		84	36	52	63	135	1-Naphthylurea, 196
8	Isopropyl methyl amine	50			0 7026 19	Ì		]		120	135	Phenylurea, 131
9	Cyclopropylamine	50		1 42120	0 82440		99	120 (di)			149	Hydrochloride, 100
10	Ethyleneimine	56			0 83224				52		142	Oxalate, 115
11	Diethylamine	56		1 387318	0 710818		42	42	60	34	155	1-Naphthylthiourea, 108
12	Allylamine	58		1 419422	0 743620			39	64	98	140	
13	DL-sec-n-Butylamine (2-Aminobutane)	63		1 39517	0 71820		76	70	55	101	139 40	
14	unsym-Dimethylhydra- zine	63		1 407522	0 791422							Hydrochloride, 81-2, Oxalate, 142, Sulfate, 105
15	Trimethyleneimine (Azetidine)	63		1 428724	0 843620						166–7	Chloroplatinate, 203, Chloroaurate, 192
16	Isobutylamine	69		1 398817	0 72425		57	53	78	82	150	,
1	n-Butylamine	77		1 401	0 7401 20					65	151	1-Naphthylurea, 149, 1-Naphthylthiourea, 108-9, Hydrochlo- ride, 195
18	2-Amino-2-methylbutane	78			0 7562		ĺ	ļ			183	
1	DL-sec-Butyl methyl amine	78 9			0 74015						78	Chloroplatinate, 151
20	Ethyl propyl amine	80 1		1 3966	0 77324							Hydrochloride, 225, Chloroplatinate, 198, Chloroaurate, 86
21	Sym-Dimethylhydrazine	81		1 420920	0 827440						147 50	Oxalate, 119, Hydro- chloride, 168
22	Cyclobutylamine	82		1 436319	0 832840							Chloroplatinate, 210 5
23	Di-isopropylamine	84			0 72222						140	N-Nitroso, 48, Chloroplatinate, 186 9, Hydrochlo- ride, 216-7
24	Pyrrolidine	89		1 427015	0 85222			,	123		112, yel, 163- 4, red	
25	n-Butyl methyl amine	90-1		1 401818	0 736745						111	Hydrochloride, 170, Chloroplatinate, 205
26	5-Amino-1-pentene	91-4				 						Chloroplatinate, 166, Chloroaurate, 195
27	DL-2-Amino-n-pentane (sec-n-Amylamine)	92			0 7384%							Hydrochloride, 168, Oxalate, 226, 131 Chloroaurate, 82-3
28	Isoamylamine	96		1 409618	0 75118					102	138	1-Naphthylurea, 132

<sup>\*</sup>Derivative data given in order m.p., crystal color, solvent from which crystallized.

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon amide	p Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
29	D-2-Methyl-n-butyl- amine (active-Amyl amine)	96			0 750525							[α] <sup>25</sup> = 5 86, Hydro- chloride, 176, Chloroplatinate, 240
30	<i>'</i>	97 8			0 8420						88 5 9 5	Oxalate, 178 9, Chloroplatinate, 172 3 (anh), 206-7, rapid htng Picrate of N-methyl deriv, 235
31 32	3-Methylpyrrolidine n-Amylamine	103 5 104		1 448020	0 8654° 0 7614°					69	106 139	Chloroplatinate, 194 2-Naphthylthiourea,
33	2-(Methylamino)-n- pentane	105			0 94720						77 8	Chloroplatinate, 138
34 35	Piperidine 2-Aminodiethylether	106 108 9		1 4530 <sup>20</sup>	0 8606 <sup>20</sup> 0 8512 <sup>20</sup>		48	93 4	96	101	152 122	Picrolonate, 204
36	Di-n-propylamine 2,5-Dimethylpyrrolidine	109 10		1 4046 <sup>20</sup> 1 4357 <sup>15</sup>	0 7384 <sup>20</sup> 0 8185 <sup>12</sup>			51		69	75 117 8	1-Naphthylurea, 93 Hydrochloride, 188 90, Chloroplatinate, 225
38 39	2,4-Dimethylpyrrolidine 1,2-Ethylenediamine	115 7 116	8 5	1 4325 <sup>20</sup> 1 454 <sup>26</sup>	0 8297 <sup>20</sup> 0 898 <sup>25</sup>	172 (dı)	244 (dı)	168 (d1)	360 (di)	102	116 7 233 (d1)	Chloroplatinate, 210
40	L-2-Methylpiperidine	117	50 1								116 7	Hydrochloride, 190, Chloroplatinate, 194
41	DL-2-Methylpiperidine	118-9		1 446424	0 84364		45		55		164	Hydrochloride, 207, Oxalate, 125
42	DL-1,2-Diaminopropane	119-20	İ		0 87815	139 (d1)	192 (di)	İ		ļ ļ	135 (di)	
- 43	Isohexylamine	125			0 75825						123 5	Hydrochloride, 220, Oxalate, 166, Chloroplatinate, 200
44	DL-3-Methylpiperidine	126		1 44624	0 8454						138 (dt)	Hydrochloride, 172, N-2,4-Dinitrophenyl deriv, 67
	2,6-Dimethylpiperidine	127-8		1 436625	0 81625		111	50			162 4	Chloroplatinate, 212
46 47	n-Hexylamine 3-Amino-n-hexane	130 130	-19	l	0 76325		40	96		77	126	Hydrochloride, 227, Chloroplatinate, 190 200
48	Morpholine	130					75	118	147	136	146	190 200
<b>49</b> 50	Cyclohexylamine Trimethylenediamine (1,3-Diaminopropane,	134 136		1 437220	0 8191 <sup>20</sup> 0 884 <sup>25</sup>	101 1,3-di 126, 107	149 1,3- <i>di</i> 140 147	89  96	148	148	250	Chloroplatinate, 240
51	1,3-Propylenediamine)  2,2,6-Trimethyl- piperidine	138 9									195 6	Hydrochloride, 236, Chloroaurate, 128
	Di-isobutylamine 4-Amino-n-heptane	139 139 40	-77	1 409320	0 745 <sup>20</sup> 0 767 <sup>20</sup>	86		55, 57		113	121	Hydrochloride, 246-7,
1	1,3-Diaminobutane 2-Amino-n-heptane	141 2 142		1 419919	0 7665‡°						240-5	Chloroplatinate, 235 Hydrochloride, 171 2 Hydrochloride, 133, Oxalate, 204-5, Chloroaurate, 63 4
56	unsym-Dietbyletbylene- diamine	145			0 82719				İ	115 (mono), 211 (di)	:	Chloroplatinate, 211
57	Furfurylamine (α - Furylmethylamine)	145 6				<b>.</b>				211 (ai)	150	Oxalate, 145, With CO₂ from air → comp , 75, Hydrochloride, 110

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
58	Cyclohexyl methyl amine	145 7	_				85-6				170	Hydrochloride, 193
59	2-Ethylpiperidine (α- Ethylpiperidine)	146 7			0 86518			64-5			133	Hydrochloride, 181, Chloroplatinate, 202
60	2,2,4-Trimethyl- piperidine	148			0 83215							Chloroplatinate, 215, Methiodide, 266
61	• •	149 50										Hydrochloride, 260, Chloroplatinate, 223, Chloroaurate, 220
62	<b>4-Ethylpiperidine</b> (γ-Ethylpiperidine)	151		1 450325	0 876°			74-5			]	Chloroplatinate, 173, Chloroaurate, 105
63	<b>3-Ethylpiperidine</b> (β-Ethylpiperidine)	153			0 87116			1			63	Hydrochloride, 141, Chloroplatinate, 183
64	n-Heptylamine	155	-23	1 41954 <sup>26</sup>	0 77720		ŧ			75	121	1-Naphthylthiourea, 68 9
65	Di-n-butylamine	159								86	59	1 Naphthylthiourea, 123
66	Tetramethylenediamine (1,4-Diaminobutane, Putrescine)	159	27		0 87745	137 (di)	177 (di)		224 (di)		249-50 (di)	
67	DL-2-Hydroxy-n- propylamine (Isopro panolamine)	163		:	0 97318						142	Chloroplatinate, 195, Hydrochloride, 73
68	Hexahydrobenzylamine	163 5		1 464618	0 8740		98, 107		İ		184 6	Hydrochloride, 254
69 70	Cyclohexyl ethyl amine 2-Ethylcyclohexylamine	164 170 1		1 468220	0 8688 0 874420			121-2		İ	133 190	Hydrochloride, 184 Chloroplatinate, 239
	2-Aminoethyl alcohol (Ethanolamine)	171		1 453920	1 02220			12. 2			160	1-Naphthylurea, 186
72	3-Amino-2-hydroxy- pentane	172			0 90618	W						N-Chloroacetyl deriv, 52 60, Monooxalate, 166, Dioxalate, 204
73	2-Aminopropyl ałcohol	173-6										Hydrochloride, 86, Chloroplatinate, 198-9
74	2-Amino-3-hydroxy- pentane	174		1 4458	0 928924							Chloroplatinate, 154, Picrolonate, 215
75	2-Fluoroaniline	176	-35 -29		1	80	113					Picrate of N,N- dimethyl deriv , 131
76	Pentamethylenediamine (1,5-Diaminopentane, Cadaverine)	178 80		!	0 9174♀	; 	135 (dt)	119		148	237	
77	n-Octylamine	180			0 77720						112	1 Naphthylthiourea, 72
78 79	5-Methyl-2-pyrazoline Benzyl methyl amine	180 181			0 94518		156		95		126 117-8	Phenylurea, 127 Chloroplatinate, 197
$-\frac{7}{80}$	Aniline	184		1 586320	1 02240	114	160	112	103	54	180	Chroropianilate, 177
	Benzylamine	184-5			0 982619	65	105	88	116, 185	156	194	
82	4-Fluoroaniline	186	-1	1 519520	1 172540	152	185					N-4-Nitrobenzoyl deriv, 181
83	DL-α-Phenylethylamine (α-Aminoethyl- benzene)	187, 185	•	:	0 939515	57	120					Hydrochloride, 158
84	1,2-Diaminocyclohexane	187				260 (dı)	:		1		210 5 (di)	Hydrochloride, 280
85	3-Fluoroaniline	187-8, yel			1 16016	84						
86	Di-isoamylamine	187-8	-44	1 422921	0 767221					72	94 5	l-Naphthylurea, 95, Methiodide, 221
87	3-Aminopropyl alcohol	188		1 45726	0 98246				}		222	Chloroplatinate, 199

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point, °C	Melting point, *C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
88	1,2,3-Triaminopropane	190				200-2 (trt)	217-8 (tri)		,	-	>269	
89	4-Amino-2,6-dimethyl- piperidine	195				]				]	220	Chloroplatinate, > 250
90	N-Methylaniline	196		1 57316	0 98920	102	63	79	94	87	145	
<b>/</b> 91	1-Phenylisopropylamine	196-7		1 518125	0 942420		159			i E	]	Oxalate, 131, Hydro- chloride, 236
	β-Phenylethylamine (β-Aminoethylbenzene)				0 95824	51	116	69		135	174, 167	
93	Benzyl ethyl amine 2-Methylaniline ( <i>o</i> -	199 200		1 568820	0 935 ¦ 7 1 005328	110-1	146	124	50 185 6	136	118 213	Hydrochloride, 184
95	Toluidine)  n-Nonylamine	201		1 3000	1 003320	34-5	49	124	165 0	130	111	
	3-Methylaniline (m- Toluidine)	203		1 568620	0 99025	65	125	95	171-2		200	
97	· ·	205								72		2-Naphthylthiourea 126, Hydrochloride,
98	DL-2-Phenylisopropyl- amıne	205				64 ini- tially, 93 on stand-					143	275 Hydrochloride 145-7
99	N-Ethylaniline	205		1 555920	0 962520	1ng 54	60		87	89	132 138	
100	4-Methylpyrazole	207		1 4920 <sup>20</sup>	1 01520						142	1-o-Nitrobenzoyl deriv, 107
101	3-Methylbenzylamine (m-Xylylamine)	207			0 9654%	235-40	150				198, 156	Hydrochloride, 208 Chloroplatinate, 214
102	2-Chloroaniline	209 207		1 589520	1 212540	87	99	129	193, 105	156	134	,
103	N,2-Dimethyl- aniline (N-Methyl-o- toluidine)	208			0 97315	56	66				90	
104	2-Methylbenzylamine (o-Xylylamine)	208	-20	1 543619	0 97729	69	88				215	Chloroplatinate,
105	4-Methylbenzylamine (p-Xylylamine)	208	13	1 536420	0 952%	107-8	137				204	
106		208		1 497 He	1 0204	29 30					144	N-o-Nitrobenzoyl deriv, 120
107	1-Phenylpropylamine	208		1 517325	0 934785		115-6	81	ļ			Hydrochloride, 190
108	2-Phenylpropylamine N,4-Dimethyl- aniline (N-Methyl p- toluidine)	210 210				83	85	67			182 131	Hydrochloride, 123 4 N-Nitroso deriv, 52, Hydrochloride, 119 5
110	2-Ethylaniline	210-11	46 6	1 558422	0 981020	111	147				194-5	
	L-Menthylamine 2,5-Dimethylaniline	212, 207 213 5,	14 2	1 559121	0 973520	145 139	156 140	138	232-3,	135	215 171	$[\alpha]_{b}^{19} -342$
	(p-2-Xylidine)	pa yel	14 2			139	140	138	119	148		
113	1-Phenylisobutylamine	214		1 512320	0 920%						166-8	Oxalate, 120-2, Hydrochloride, 275 7
	3-Methylpyridazine 2,6-Dimethylaniline (m-2-Xylidine)	215 215, 218	11 2	1 561020	1 0486 <sup>26</sup> <sub>26</sub> 0 9842 <sup>20</sup>	177	168		212	204	143-4 180	
116	4-Ethylaniline	216, 214	-6	1 555020	0 969020	94	151		104			
1	2,4-Dimethylaniline (m-4-Xylıdıne)	217		1 56120	0 978340	133, 130	192	130	181	152	209	
118		218			1 173511						133	
119	2,4-Dimethylbenzyl- amine	218-9									223	Hydrochloride, 212, Chloroplatinate, 226

<sup>\*</sup>Derivative data given in order  $\ m\ p$ , crystal color, solvent from which crystallized



No	Name	Boiling point, *C	Melting point, *C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon amide	p- Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
120	2-Amino-N,N-dimethyl- aniline	219				72	51				138 40	
121	3,5-Dimethylaniline (m-5-Xylıdıne)	220	98	1 558120	0 970620	144, 140	144-5			153	200	N-Formyl deriv , 76
122	N-Ethyl-3-methylaniline (N-Ethyl-m-toluidine)	221, 215					72					Hydrochloride, 159, Chloroplatinate, 182
123	3,5-Dimethylbenzyl- amine	221		1 530520	0 950%						225	Hydrochloride, 245, Chloroplatinate, 204
124	2,3-Dimethylaniline (o-3-Xylidine)	221-2	3 5	1 568420	0 993120	135	189				221	Hydrochloride, 254, N-Formyl deriv, 102
125	1-Aminoindane (1- Hydrindamine)	222					142 3				207	
	3-Phenylpropylamine 2-Methyl-4,5,6,7-tetra-	222 222			0 976 <sup>25</sup> 0 987 <sup>10</sup>		57 8	86-91			152 3 141	Hydrochloride, 218 Methiodide 195,
128	hydroindole N-n-Propylaniline	222			0 94918	47		54		104		Chloroplatinate, 187
129	2-n-Propylaniline	222-4				104-5	119				151	Hydrochloride, 173
130	2-Chloro-4-methylaniline α-Amino- <i>n</i> -butylbenzene	1			0 9367%	113	137 128				!	Chloroplatinate, 184,
132	trans-9-Aminodecalin	223	-25	1 49220 1 49220	0 93920	183	148 9					Hydrochloride, 288 N-Formyl deriv, 172
133	γ-Amino-n-butylbenzene	223		1 515220	0 928945		108, lgr					Hydrochloride, 144, Chloroplatinate, 220
134	2-Methoxyaniline (o-Anisidine)	225	5-6			85, 88	60, 84	89	127	136	200	N-Formyl deriv , 84
135	4-lsopropylaniline (p-Cumidine)	225			0 95340	102	162				i.	
136	4-n-Propylaniline	225 227			0 94018	934	115		122 3			Hydrochloride, 203 4
137 138	N-Isobutylaniline α-Methyl-α-phenyl- hydrazine	227		1 582420	0 940;	92	153	132	122 3			
139	4-tert-Butylaniline	228	17	•		173	140		179-80			N-Formyl deriv , 59 Hydrochloride, 270-4
140	cis-9-Aminodecalin	228	-135	1 498 <sup>21</sup>	0 95121	127	147					N-Formyl deriv, 165-6
141	2-Ethoxyaniline (o- Phenetidine)	229				79	104	102	164	137		
142	2,4,6-Trimethylaniline (Mesidine)	229, 232				216	204	137	167	193	189-91	
143	2-Aminoindane (2- Hydrindamine)	230				127	155				239	Hydrochloride, 241
144	3-Chloroaniline	230 236		1 593120	1 2225 15	72, 78	119–20	121	138, 210	124, 116	177	
145	2,2'-Diaminodiethyl- sulfide	231 3									212	Dihydrochloride, 131
146	1,2,3,4-Tetrahydro- isoquinoline	233			1 06423	46	129	154		į	200, 195	
147 148	2-tert-Butylaniline 3-Amino-4-(dimethyl-	233-5 234		1 545320	0 97715	159-61	,				151	Hydrochloride, 192-3
149	amino)toluene 4-Isobutylaniline	235, pa				127			136-7			
150	4-Aminoindane (4-	yel 236	-3			126	136					
151	Hydrindamine) 2-Aminoundecane (2- Aminohendecane,	237			!	58					111	Hydrochloride, 84
152	sec-n-Undecylamine) unsi m-Ethylphenyl- hydrazine	237			1 01815				í		i	Hydrochloride, 137, Reduces warm Fehling

<sup>•</sup> Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
153	sym-Ethylphenyl-	238 9		1 5515	1 00415		100					Hydrochloride, 164,
154	-	240	26		1 51 20	118	149					Oxalate, 167 Hydrochloride, 221
155	(3-Bromo-p-toluidine) 1-Aminoundecane (1- Aminohendecane, n- Undecylamine, n-	240	15-6			48	60				!	Hydrochtoride, 190
156	Hendecylamine) 4-Chloro-N-methyl- aniline	240			1 169115	92-4					153	Nitrosamine, 51
157	4-Chloro-2-methylaniline	241	29			140						
158		241		1 54319	0 99420	71	102					Hydrochloride, 207
159 160	(p-Cymidine) N-Butylaniline Phenylhydrazine	241 243	19 23	1 5381 <sup>20</sup> 1 6081 <sup>20</sup>	0 9358 <sup>20</sup> 1 0978 <sup>20</sup>	128	56 168,	148	56 151	172		
161	α,α'-Diamino-m-xylene (m-Xylylenediamine)	245 8		<u> </u> 		107 (d1) d1 134 5, bz	177 (di) N,N'-di 172				185-90	Dihydrobromide, 266
162	2-Chloro-6-methoxy- aniline (3-Chloro-o- anisidine)	246 sl d	1			123	135					
163	3-Ethoxyaniline (m- Phenetidine)	248				97	103		157	138	158	
164	4-Ethoxyaniline (p-Phenetidine)	248, 254	2 3		1 06546	137	173	143	106	136	69	
165	1,2,3,4-Tetrahydro- quinoline	250	20	1 59324	1 0544		75	67	ĺ			Ti
166	2-Aminoacetophenone	250 2d	20			76 7	98		148			Semicarbazone, 290, Oxime, 109, Hydro- chloride, 168 d
167 168	3-Bromoaniline 3-Methoxyaniline (m-	251 251	18	1 62620	1 57940	87 81	120 136		68	143	180 169	Hydrochloride, 167-8
169	Anisidine) 3-Bromo-2-methylaniline	254				163	176-7					
170	(6-Bromo-o-toluidine) 4-Amino-1,2,3,5-tetra- methylbenzene (Iso-	255	23 4			215-7	,		į		200	
171	duridine) Dicyclohexylamine	255 sl	abt 20	1 48818	0 92518	103	153				173	
172	6-Methyl-1,2,3,4-tetra- hydroisoquinoline	d 256			1 0235						205	Hydrochloride, 195-7. Methiodide, 144-5, N-Nitroso deriv, 98
173		261				104	172					11 1111 000 2011 172
174	aniline 4-n-Butylaniline	261			0 9454	105	126					Chloroplatinate, 200-2
175	1-Amino-5,6,7,8-tetra- hydronaphthalene	261 3		1 589623	1 062516	158						Hydrochloride, 259 61
176		264					70-2				153-4	Hydrochloride, 175
177	4-Methylindole 2-Amino-4-chloro-N,N-	267 267 8	5		1 06240	90				: 	194 5 191	
179	dimethylaniline DL-3-Aminopropylene- glycol (2,3-Dihydroxy- propylamine)	268 part d		1 4910	1 1754⁰		O,N-di 109 O,O,N-					Chloroplatinate, 185, Picrolonate, 220, O,N-di-4-Nitroben- zoyl deriv, 139

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

## 1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, *C	Melting point *C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl throurea	Picrate	Miscellaneous
180	Diethanolamine (Di-(2- hydroxyethyl)-amine)	270	28	1 477620	1 09664"						110	Nitrate, 69, Chloro- platinate, 160
181	3-(Dimethylamino) aniline	272			0 99525	87 69 (di)	163 4				187	N-Chloroacetyl deriv
182	1-(N,N-Diethylamino) naphthalene	290		1 596120	1 015%						152 4	1,3,5-Trinitrobenzene add comp, 95, scar
183	1-(Methylamino) naphthalene	294			[ [	94 5	121		164			
184	Dibenzylamine	300		1 574322	1 025622		112	68	159			Hydrochloride, 256
185	α-Aminodiphenyl- methane (Benzhydryl- amine)	303-4		1 5963215	1 063501 5	146 7	172 167				205 6	N-Formyl deriv, 132
186	l '	313			1 031 15	i i	ļ				212 3	Oxalate, 158, Chloro- platinate, 188
187	2,3-Diphenylpropyl- amine	315 7	1		į	85 (d1)						Hydrochloride, 188 90, Chloroaurate, 144 5
188	2-(Methylamino) naphthalene	317, 309				51	84	107	78		145	Hydrochloride, 182-3
189	2-(N,N-Diethylamino) naphthalene	320 2										1,3,5-Trinitrobenzene add comp , 116, blk Hydrochloride, 177, Chloroplatinate, 95

<sup>\*</sup>Derivative data given in order  $\,$  m  $\,$  p , crystal color, solvent from which crystallized

1. Primary and secondary amines a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acetyl derivative)\*

No	Name	Boiling point, °C	Melting point, *C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
1	3-Aminostyrene	112 512			1 021620	74 5	90, bz - lgr , 126, al -w					Polymerizes readily
2	2-Bromo-4-ethoxyaniline (3-Bromo-p-phenet-idine)	16023				97						
3	3-Aminothiophenol	180-9016	ŧ 			N,S-di 97 di)				! !		Hydrochloride, 232
4	2-n-Butylamline	122 512			0 95320	100	116 7	İ				Hydrochloride, 137
5	2-(2-Aminophenyl)ethyl alcohol	147 83 5	<u> </u>	1 584919		103 5						Hydrochloride, 126
6	6-Amino-3,4'-dimethyl- biphenyl	165 74				104	!					Hydrochloride, 216-26
7	2,2-Diphenylpropylamine	179-8222	1	ļ	1 02718	106 7	82-3	l	ļ	1		Hydrochloride, 261
8		15631				114				<u>}</u>		Hydrochloride, 228
9	2-Aminostyrene	97 8 <sup>8</sup>	İ	1 613021	1 0152	129		l	ļ	ļ	ļ	Polymerizes readily
10	2-Aminothiophene	77 9''	}			161 2	172-3					Oxidizes rapidly, N-2-toluenesulfonyl deriv, 183-4
11	4,4'-Dıamino-2,3'- dimethylbiphenyl	24412				N N'-di 253, tetra 191	N,N'-di 245					

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE XVIII. ORGANIC DERIVATIVES OF AMINES 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon- amide	P- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
1	Di-n-heptylamine	1	271						117-20	
2	4-Aminostyrene	23 5	984	142	160-1		İ	İ		D2 1 012 n2 1 625
3	3-Bromo-4-methylaniline	25-6	254-7	117-8	132			]	i	"
-	(2-Bromo-p-toluidine)			*	1.5-			1		1
4	2-Amino-3-methylpyridine (2- Amino-β-picoline)	26	224	64	220				229	5
5	2-Aminothiophenol	26	234	135 (N,S-d1)	154 (N,S-di)					
6	n-Dodecylamine	27–8	247-9				73			Hydrochloride, 98, Chloroplatinate, 215
7	DL-2,6-Dimethyl-1,2,3,4-tetra- hydroquinoline	31-2	267		103-5					Hydrochloride, 180 3
8	5-Bromo-2-methylanilme	32	253	165	ł	1				]
	(4-Bromo-o-toluidine)	}	part d	1		İ	1	1		
9	1-Amino-2-methylnaphthalene (2- Methyl-1-naphthylamine)	32		188	180					
10	2-Bromoaniline	32	250	99	116			146 161	129	
11	4,4'-Dimethyldibenzylamine (p-Dixylylamine)	32 5	22030						153	Nitrosamine, 52, Hydrochloride, 272
12	2-Aminodibenzyl	33	173-8311	117	166			]	167-8	Hydrochloride, 198
	3-lodoaniline	33 27	145 615	119	157		128	l .	107-0	Trydroemoride, 198
		34	22040-50	184	192	ļ	120			
14	unsym -Diphenylhydrazine	1	220.		1	1	1		222	
15	$\alpha, \alpha$ -Diamino-1,4-dimethylbenzene	35	Ì	194 (tetra)	193		]		232	
16	(p-Xylylenediamine) 3-Bromo-5-methylaniline (5-Bromo-	36	255 60	171 2	(N,N'-dı)					
	m-toluidine)		l		1	İ	1			
17	4-Amıno-N-methylaniline	36	258	63	165	İ	ł	]	206	
18	Pentadecylamine	36, 33	300	72	ļ		ļ	[ [		Hydrochloride, 199
19	N-Benzylanılıne	37	298	58	107	119	148-9	103	48	
20	3-lodo-4-methylaniline (2-lodo-p-toluidine)	37-8		130						Oxalate, 103
21	5-Aminoindane (5-Hydrindamine)	37-8	247-9745	106	137		ļ	1 1		
22	2-Amino-5,6,7,8-tetrahydronaph- thalene (5,6,7,8-Tetrahydro-2-	38	275-7713	107	167				204	
	naphthylamine)		1							
23	2-Amino-5-bromonaphthalene (5-							1 1		
	Bromo-2-napthylamine)	38	207 1016	165	109	l		t 1	216	N-Benzal, 63
24	2,2-Diphenylethylamine	38	18033	88	144 5				212 3	Phenylurethane 191 2, Hydrochloride, 256-7
25	2,3-Dimethyl-1,2,3,4-tetra- hydroquinoline	38-9			92				178	
26	2-lodo-4-methylaniline (3-lodo-p-toluidine)	40		133	161					Oxalate, 120, Hydro chloride, 188
27	2-Chloro-4,6-dimethylaniline (5-Chloro-m-4-xylidine)	40		205–6	148					2-Naphthylthiourea 154
28	2-Amino-6-methylpyridine (6- Amino-α-picoline)	41	208-9	90	90				202	Hydrochloride, 155, Chloroplatinate, 218
29	4-Amino-N,N-dimethylaniline	41,53	262	132-3	228				188	•
	1,6-Diaminohexane	42	204-5		155 (di)	154 (dı)			220	
ا ٥٠	(Hexamethylenediamine)		20, 5	, (u.)		(4.)		[		
31	1,3-Diaminoisopropyl alcohol	42	235						230	Hydrochloride, 185, Chloroplatinate, 240
22	4-Amino-3-methylbiphenyl	43	19015	165, 158	189				Į	N-Benzal, 108
- 1	2,4'-Diaminobiphenyl	45	363	202 (dt)	278 (dı)					
		45	200	202 (ai) 147	158	120	118	141	182	
- 1	4-Methylaniline (p-Toluidine)					120		471		Oxidized readily → 4,4 -
35	4-A minothiophenol	46	140-516	154 (N-), 144 (132) (N,S-di)	180 (N-)					diaminodiphenyl sulfide, 104 5

<sup>\*</sup>Derivative data given in order m.p., crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
36	4-Aminobenzyl cyanide	46		97 (mono) 152-3 (di)	176-7				185	N-Formyl, 135
37	2-A minopropiophenone	47	93º *	71	130				i	Oxime, 88-9, Semicarba- zone, 190, N-Propionyl, 51
38	<b>3-Bromo-4-ethoxyaniline</b> (2-Bromo- p-phenetidine)	47	18920	114					178 9	
39	4-Amino-2-thiocresol	47		95 (N-), 125 (N,S-dt)						S-Me , 47
40	<b>2-lodo-5-methylaniline</b> (4-lodo- <i>m</i> -toluidine	48, 38		151, 146					:	N-Formyl, 129
41	1-Amino-4-fluoronaphthalene (4 Fluoro-1 naphthylamine)	48	16216	İ	197					Hydrochloride, 280
42	4-Aminodibenzyl	48			170 1					Hydrochloride, 210, Chloroplatinate, 286-9
	3.4-Dimethylaniline (o-4-Xylidine, 4-Amino-o-xylene)	49 49, vel	224	64		118		:		N-Formyl, 52, Hydro- chloride, 256 N-Me, 59
44	2-Ethoxy-6-nitroaniline	49, yei 49	335-40	62	91		ļ			Trans.
45 46	Heptadecylamine 2-Aminobiphenyl	49	299	121	102			;		N-Formyl, 75, N-Propionyl, 65
47	4-Amino-2-methyldiphenylamine	49 50	1964	139 40						Hydrochloride, 185 7
48	2-Bromo-4,6-dimethylaniline (5-Bromo-m-4-xylidine)	49 50		196 7	186				122	
49	2,5-Dichloroaniline	50	251	132	120		}		86	Hydrochloride, 191 2
50	1-Aminooxindole	50	1	186-7	189		}			}
51	<b>1-Aminonaphthalene</b> ( $\alpha$ -naphthylamine)	50		159	160	167	157,	165	163 181	
52	1-Amino-1,2,3-triazole	51	]		151		]		130	Hydrochloride, 114
	2-Amino-1-methylnaphthalene (1- Methyl-2-naphthylamine)	51	,	188 9	222					
54	Methyl-1 naphthylamine)	51-2	17612	175 6 166 7	188 9					Hydrochloride, 233-4
	1-Amino-4-methylnaphthalene (4 Methyl-1-naphthylamine)	51-2	260	150	250-7				200	N-Formyl, 177 8, Hydro
	4-Chloro-2-methoxyaniline (5-Chloro-o-anisidine)	52, 40	253	157 8	68	254			200	chloride, 238 N-Nitroso, 171
57 58	Indole 2-Aminodiphenylmethane	52	19022	135	116	[234	]		]	Hydrochloride, 137
59		52 3	318		114-5					
60	4-Aminobiphenyl	53	302	171, 120 (di)	230		255 160			N-Formyl, 172
61	1,4-Bis-(methylamino)benzene (s1 m-Dimethyl-p-phenylene- diamine)	53	15017						186	N,N'-Dinitroso, 148
62	Diphenylamine	53-4	1	101	180	124	141	152	182	
63	DL-α-Aminobenzyl cyanide	55			159 60	]	]	]	160-1	1
64	4-Methoxy-3-nitroaniline (2-Nitro-p-anisidine)	57, or		153						N-Chloroacetyl, 150, N,N-D1-Me, 46, red
65	5-Bromo-2-ethoxyaniline (4-Bromo-o-phenetidine)	57 53		133					135 7	
66	2-Amino-5-bromobiphenyl	57		130	162				1	
67	4-Methoxyaniline (p-Anisidine)	58	240	130, 127	154, 157	95	114	157, 171		
68	Methyl-1-naphthylamine)	58-9	16210	182-3	204					1
69	4-Bromo-2-methylaniline (5-Bromo-o-toluidine)	59	240	156-7	115					

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

		, <u> </u>		·	<b>,</b>		,			
No	Name	Melting point C	Boiling point C	Acetamide	Benzamide	Benzene sulfon amide	p Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
70	2-Amino-1 chloronaphthalene (1	59	-	147	98	131				N Formyl 136
	Chloro 2 naphthylamine)									
71	2 Aminoazobenzene	59		126	122					
72	1-Amino 2-chloronaphthalene (2	59 60		191		}	Ì	ì	ì	ì
	Chloro I naphthylamine)			(mono)	İ					
	· · · · · ,	1		88 (di)						
73	5-Methylindole	60	267	00 (21)			1			
	2-Aminopyridine	60 58	1	]_,			Ì	ì	151	
74	1 1 1 1		204	71	165 (dı)		ļ		216 7	
75	3-(3 Indolyl)-propylamine	60 4					}		146 9	Hydrochloride 170
				1			1		156	•
76	2-Methylindole	61	271 2	Ì	Ì	Ì	Ì	1	139	1 3 5 Trinitrobenzene add
		i				ļ			ļ	comp 152 N Formyl 75
77	2-Iodoaniline	61 58		109	139				112	Hydrochloride 153 4
78	1 Naphthyl phenyl amine (N	62	2262	115	152					
	Phenyl I naphthylamine)		1	Ì		1	1	}	Ì	
79		62		94			l		106	
	(2 Chloro p anisidine)	102		^7					186	
80	1-Amino-3 chloronaphthalene (3	62		197	1,62					
80		]62		197	162	Ì		Ì	]	Hydrochloride 219
0.1	Chloro I naphthylamine)			l •			ļ			
	2-Amino-4,4 -dimethylbiphenyl	62 3		118 9	95 6		ŀ			
82	8-Amino-6-methylquinoline	62 4		91 2	l		l	Į		1 3 5 Trinitrobenzene add
					ļ	İ	i		ļ	comp 139
83	2-Amino-1 bromonaphthalene (1	63		mono 140						N Propionyl 139
	Bromo 2 naphthylamine)			di 105		ŀ				N Benzal 93 4 1 3 5
				Į	ļ			ļ		Trinitrobenzene add
					1					comp 192
84	1,3-Diaminobenzene (m Phenylene	63	282 4	191 (dı)	240 (di)	194	172		184	.,_
0-1	diamine)	05	202 4	87 9	125	1.,,				
	diamine)			(mono)	(mono)		<b>,</b>	ļ		
85	2,4-Dichloroaniline	63	245	145	117	128	126		106	
		63 4	243	123 4	155 6	120	120		100	
80	2-Amino 5 methylnaphthalene	05 4		123 4	133 0		}			
~=	(5 Methyl 2 naphthylamine)			<b>)</b>	1	i		•	ì	Hudeocklorido 366
87	3-Bromo-4-methoxyanılıne	64		[111				i		Hydrochloride 255
	(2 Bromo p anisidine)			1					ŀ	
88	2,5-Diaminotoluene	64	273 4	220 (di)	307	2 mono	2 mono			
				<u> </u>		147	150	1		
89	3-Aminopyridine	64	250 2	mono 133	119					
				di 88						
90	9-Атповиотепе	64		262	260 1					Hydrochloride 255
	4-Methylphenylhydrazine	65	240 4d	121	1 N mono	]				
, -	(p Tolylhydrazine)			1	68 70 2	-				
					N mono					
				Į	146	Į	Į	l	l	į
92	4-Aminobenzył alcohol	65		188 (O N	4 mono	!				Hydrochloride 217
14		<b>  "</b>		di	150					
0.2	2 Promo 6 mothovyopulupo	65		u.,	90					Hydrochloride 225
93	2-Bromo-6-methoxyaniline	100		ļ	1					11, 110011101100 122
٠.	(3 Bromo o anisidine)	(5.6		260 ( 45	222 (227)					N N Diformyl 220
94	1,3-Diamino-2,6-dimethylbenzene	65 6		> 260 (di)	232 (227)					Difference 220
	(2 4 Diamino m xylene)	l			(dı)					11
95	Aminoacetamide (Glycineamide)	65 7		ļ	1					Hydrochloride 186 9
			•	]				ĺ		Chloroaurate 197 8 Hot
				1			ĺ			$H_2O \rightarrow glycine + NH_3$
96	2-Aminocyclohexanol	66	219							Hydrochloride 175
				}	1	}				N Phenyl 150
97	2-Amino-5-methylbenzophenone	66 yel		159	118		1	1	145	
98	4-Bromoaniline	66	245	168	204	134		148	180	
	1,8-Diaminonaphthalene	66		311 2 (di)			207 (dı)			
			L	L	L	L		<u> </u>		

<sup>\*</sup>Derivative data given in order m p crystal color solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon- amide	p Toluene sulfon-	Phenyl thiourea	Picrate	Miscellaneous
		ļ		ļ	ļ	annoc	amide			
100	3-Amino-5-bromopyridine	66–7	15012	76-8 (hyd)					212-3	Chloroaurate, 185 7
				127				[		
				(anh)	1	1		]	)	
101	1-Amino-8-methylnaphthalene	67 8	}	183-4	195-6	1		İ		
	(8-Methyl-1-naphthylamine)		}		222	}	[			N. 4. Nistanhamansi 260
102	4-Iodoaniline	67-8	į	184	222	1		153		N 4-Nitrobenzoyl, 269 N-Benzal, 86
103	1-Amino-2,4,5-trimethylbenzene	68	ĺ	162	167	136				i Denzai, oo
	(Pseudocumidin)		İ					{		
104	2,2'-Diaminodibenzyl	68	1	249 (di)	255 (dı)	ļ	İ	l	225 30	
105	2-Amino-4-methylnaphthalene	68	}	172 3	194-5	•				
106	(4-Methyl-2-naphthylamine)		}	95	105	83		1		
100	3-Nitro-N-methylaniline 1-Amino-3-bromonaphthalene	68 70	}	174	166	83	1	l I		Hydrochloride, 247
107	(3-Bromo-1-naphthylamine)	1,0	ļ	1.73	100	}	1	}	}	Trydrockionae, 2 tr
108	1-Amino-5-methyl-1,2,3-triazole	70	ļ		158, 138	[	1			N-Benzal, 67 8, Hydro-
	- · ·	1			(di)	-		[ ,		chloride, 138
109	8-Aminoquinoline	70, 65,	Ì	103	98	}	154-6		İ	Hydrochloride, 208 9
	(% ) (% ) (% ) (% ) (% ) (% ) (% ) (% )	yel	Ì	02.04	00 110		1	Ì		
110	2-Nitroaniline	71, golden-	1	92, 94	98, 110	104	142	}	73	}
-		yel	1	1		}				
111	3,4-Diaminotriphenylmethane	71 2	ţ	226 (di)	243 (di)	ļ				
112	4-Chloroaniline	72	ļ	179, 172	192	122	95, 119	152		
113	8-Amino-6-Chloroquinoline	73								Hydrochloride 208
			}	1	}		]			Chloroplatinate, 212,
114	4-Aminophenylurethane	73-4		202, 181	230	Ì	)			Methiodide, 178
***	(N-carbethoxy-1,4-	173-4		202, 101	250		}			Hydrochloride, 242
	diaminobenzene)	1	}	l			}			
115	4-Aminodiphenylamine	75 (anh )	,	158	203		ļ	,		
	3,5-Dimethylindole	75	278		ļ	ļ	[		180	
117	Duridine (3-Amino-1,2,4,5-	75	261	207	1		ĺ			Hydrochloride, 260
118	tetramethylbenzene) 1-Amino-3,4,5-trimethylbenzene	75	240	163 4						N-Formyl, 98
	2-Amino-1,4-dimethylnaphthalene	75	333	219-20	Ì		ĺ			11-1 01111/1, 50
	(1,4-Dimethyl-2-naphthylamine)	1			İ		1			
120	4-Nitromesidine (2-Amino-4-	75		191	169	163	ļ			\$
121	nitromesitylene)	120	ł		ĺ		ļ			
121	2-Methoxy-6-nitroaniline (3-Nitro-o-anisidine)	76, yel	ł	158-9	(		l			N-Me, 58, red
122	2-Bromo-1,4-diaminobenzene	76	1	200(di)	235(di)					
	(2-Bromo-p-phenylenediamine)	1								
123	4,6-Dimethyl-2-nitroaniline	76, 70	}	176, 173	185		]			
,,,	(5-Nitro-m-4-xylidine)	77-8	}	194-5	173-4		}		210 d	
124	1-Amino-5-methylnaphthalene (5-Methyl-1-naphthylamine)	1''-0		174-3	1,3-4		]		2.00	
125	. , , ,	78	263	204, 206	174	152-4	1		83	
	4-Methyl-3-nitroaniline	78		148	172	160	164	171		}
	(2-Nitro-p-toluidine)	1		1			,,,		124	
127	· ·	79 79		146	134 140		134		124	
128	1-Naphthyl 4-tolyl amine 2-Aminodiphenylamine	79–80		124 121 (2-N-)	136 (2-N-)					
	2,4-Diaminophenol (4-Hydroxy-m-	79-80	]	220-2	253 (dı)				120	
	phenylenediamine)	]	}	(2,4-N-)	1					
}		1	1	180-2	1					
,,,	4 A minonunggolo	80.3		(tri)	173 (dı)				193-4	
131	4-Aminopyrazole	80-2	<u> </u>		173 (41)	L			1/3-4	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	P- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
132	4-Bromo-3-methylaniline (6-Bromo- <i>m</i> -toluidine)	81	240	103-4						N,N-D1-Me , 55
133		81		209 (di)					203 4	N,N'-Diformyl, 163
134	1	81	1624	mono 89,	159 (2-N-)	1			İ	N,N'-Diformyl, 137
	, , , , , , , , , , , , , , , , , , , ,			di 161	190 (dı)					_
135	3-Aminoacenaphthene	81		192 3, al	209, al		]		221	N-Formyl, 151, Alc,
						ľ			1	FeCl <sub>3</sub> → bl -vlt col
136	2-Aminobenzyl alcohol	82	270 80	N-mono	O- 198-9				110	Hydrochloride, 108
			part d	114		ļ				
137	,,,	82 3							194-5	Hydrochloride, 153, N-Formyl, 117, Chloro- platinate, 230
138	4-Chloro-3-methylaniline	83	ļ	91	119				l	2-Naphthylthiourea, 158
120	(6 Chloro-m-toluidine)	02.4	262.4	210					122 4	
	2,6-Dibromoaniline	83-4 84	262-4	210 104	77 8				123-4 194	
140	5-Chloro-2-methoxyaniline (4-Chloro-o-anisidine)	04	1	104	/′°			1	174	
141	4-Aminotriphenylmethane	84, bz	24812	168	198			i	[	N,N-Di-Me , 132
142		84	240	207	174					11,11 21 110 , 122
	(3-lodo-1-naphthylamine)			]						
143	4-Aminobutyrophenone	84		142						Hydrochloride, 178
144	4,4'-Diaminodiphenyl disulfide	85, yel,	ĺ	205 (di)			1		1	N,N'-Dicarbethoxy, 136-7
		106								
145	7-Methylindole	85	266		84				176	
146	2-Amino-4-bromobenzaldehyde	85				ļ		ĺ		Oxime, 194, Phenylhydra-
147	2,2'-Diaminodiphenyl sulfide	85 6		140 (4)	162 2 (4)			]		zone, 215
147	4-Aminoveratrol (3,4-Dimethoxy-	85 6	174 6	160 (dt) 133	162 3 (di) 177					Chloroplatinate, 227
170	aniline)	05 0	11/4 0	1133	1''	1			1	Chloropiatinate, 227
149	2-Aminophenanthrene	85, pa	1	225	216	}			\ \	
	•	yel					İ			
150	4-Aminobenzonitrile	86	l	205	170			Ì	150	N-Formyl, 188-9,
			[							N-Propionyl, 169
151	4-Iodo-2-methylaniline (5-Iodo-o-	87 92		170, 162	184				189	N-Benzal, 55, Phenyl-
,,	toluidine)	0.7			100	İ				urethane, 232
152•	4-Aminoacenaphthene	87		175 6	196				190-	
\ 153.	3-Aminoacetanilide	87 9	Ì	191		-	241		200	
1154	2 Aminophonopthropo	87 5		200-1	213		271			
155.	4-Amino-3-methyl-1-phenylpyrazole	88	312	94 5	181			1	138	N-Formyl, 112 (anh ), 81
				(hyd),						(hyd), Chloroplatinate,
			1	120(anh)		1	1		}	226
156.	2-Hydroxy-3-methylaniline	89	Ì	N-mono						N-Acetyl of Me eth, 100
	(3-Amino-o-cresol)			78~9	ļ		l .			
`157 •	3,4-Diaminotoluene	89 90	265	210 (dt), 95 (3-N), 131 (4-N)	263-4 (dı)	178-9 (di)	4-mono 140			
∖ 158₃	2-Nitrophenyłhydrazine	90, red		140 1, di	166				ļ	N-Formyl, 177
				57 8		1	1			
	2,2'-Diaminodibenzyl dısulfide	90-1	Ì	202-5 (di)		Ì		)		N,N'-Dipropionyl, 190-1
	4-Chloro-1,3-diaminobenzene	91	]	242 (dı)	178 (di)		215			
161	1-Amino-2,6-dimethylnaphthalene	91		211	219-20					
162-	(2,6-Dimethyl-1-naphthylamine) 1-Amino-4-mercaptonaphthalene	91 3		N-mono	1	1		1		S-Me , 54
<b>₹1</b> 02 <b>©</b>	(4-Amino-1-thionaphthol)			173		[	İ			5 1120 , 5 1
163	2-Methyl-3-nitroaniline	92 97	1	158	168	1				
	(6-Nitro-o-toluidine)				Ī					
<b>∖164</b>	•	92	305d	158	167	1	1			1-Naphthylthiourea, 171
	(3-Nitro-o-toluidine)					1	Į.			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

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1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

		,		<del>,</del>	,		<del>,</del>	,		
No	Name	Melting point, *C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	p- Toluene sulfon amide	Phenyl throurea	Picrate	Miscellaneous
1654	3-Bromo-2-hydroxy-5-methylaniline (3-Amino-5-bromo-p-cresol)	93		N-mono 129 di	N-mono 185 di	N- mono				
		1		169	166	157	ì			
1663	4-Chloro-2,6-dibromoaniline	93		226	194	di 230				
	2,2'-Diaminodiphenyl disulfide	93	}	156 (dı)		}	}	1	141 (di)	
168	1,18-Diaminooctadecane	93	l		150 (dı)		1			Hydrochloride >225
169	4,4 -Diaminodiphenylmethane	93	2329	236 (d1) (228)						N,N -Dibenzal, 130
170	3-Nitrophenylhydrazine	93, yel		145 150 (di)	151 153 (dr)		[			
171	7-Aminoquinoline	93 4 (anh ), 73		167	189					Chloroplatinate, 225
	2.4	(hyd ) 94	1	1.70 03 (1)	201	}	ł	l	1	
172	2-Ammodibenzfuran 3-Ammogumoline	94 84		178 83 ( <i>di</i> ) 172 167	201		l		210	1
174	7-Amino-2,4-dimethylquinoline	94 100	>300	212					210 215 7	
175	Skatole (3 Methylindole)	95	267	68					170 1	Hydrochloride, 167 8, N-Propionyl, 45
176	2-Chloro-4,6-dibromogniline	95		227	192			İ		i N-Fropionyi, 43
177	4-Hydroxybenzylamine	95		{	}		ŀ		]	Hydrochloride, 195, N-Acetyl of Me ether, 96
178	1-Amino-4,5-dimethyl-1,2,3- triazole	95	į						124 5	Hydrochloride 131, Chloroplatinate, 215
179	1-Amino-8-hydroxynaphthalene (8 Hydroxy-1-naphthylamine 8 Amino-1-naphthol)	95-7		N-mono 181 N O di	N-mono 193, N,O-di		Mono 189		163 4	N-Formyl, 140 50
180	5-Amino-2-methylpyridine	96		118 126	206 111		.07		201	Dibudro ablanda 215 0
181	(5 Amino-α-picoline) 4,4'-Diamino-3,3'-dimethyl-	96		di 220	dı 233					Dihydrochloride, 215 8
	diphenyl sulfide				ai 233					Dihydrochloride, 248-9
182	6,6'-Diamino-3,3'-dimethyl- diphenylmethane	96		152					199	Dihydrochloride, 248-9
183	N-Ethyl-4-nitroaniline	96	}	(tetra) 119	98		107			
-	2,4-Di-iodoaniline	96		141 171	181		,			
185	1-Amino-8-nitronaphthalene	97, red		191		194		ļ		
	(8-Nitro-1-naphthylamine)									
186	3-Aminobenzyl alcohol	97		N mono 106-7	N-mono 115 N,O-di					
187	5-Bromo-2-methoxyaniline (4-Bromo-o-anisidine)	97-8		160	113 4					
188	2-Amino-d-methylpyridine (2-Amino-γ-picoline)	98		102-3	114, 182 3 (di)				227	
189	2-Aminophenacyl alcohol	98		N-mono 141	N,O-di 167					Phenylhydrazone, 198
190	1-Amino-4-chloronaphthalene (4-Chloro-1-naphthylamine)	98		186	107					
191	1,2-Diaminonaphthalene	98	<u> </u>	234 (dı)	291 (dı)	1-mono 215				
192	4-Amino-4'-methylbiphenyl	99	190¹8	221						Hydrochloride, 280 3
193	3-Aminoacetophenone	99		128-9			130			Semicarbazone, 196
	2,4-Diaminotoluene	99		N,N'-di 224	224 (di)	2-mono 138, 2,4-di	4-mono 160, 2,4-di			,
						192	192~3			

<sup>\*</sup>Derivative data given in order, m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, *C	Acetamide	Benzamide	Benzene sulfon amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
195	4-Amino-3,2'-dimethylazobenzene	100, yel		185 (mono), 65 (75) (dt), lgr						N-Chloroacetyl, 171-2
196	1,2-Diaminobenzene (o-Phenylene-diamine)	102	256-8	185 (di)	301 (dı)	185	260 (dı)	į	208	
197	1-Amino-4-bromonaphthalene (4-Bromo-1-naphthylamine)	102,95		193						N-Formyl, 172, 1,3,5-Tri- nitrobenzene add comp, 196
198 199	2-Naphthyl 4-tolyl amine 3,4-Diaminobiphenyl	103		85 3-mono 211 4- mono 155, 3,4- di 163	139 3-mono 186, 4- mono 221, 3,4- di 248					
200	6,6'-Diamino-3,3'-dimethyl- diphenyl sulfide	103-4		165 (d1)	185 (dt)				179 (d1)	
	2-Amino-8-nitronaphthalene (8-Nitro-2-naphthylamine)	104, red		196	162			į		
	Piperazine	104	140	mono 52, di 144	mono. 75, di 196	282 (d1)	173		280	
203	4,4'-Diaminodibenzyl sulfide	104-5		188 (di)	224 (di)	1	ł		1	l
204	3-Amino-4,4'-dimethylbiphenyl	104-5		156-7	160 1	į	ļ	l		Hydrochloride, abt 230
205	1,3-Diamino-4,6-dimethylbenzene (4,6-Diamino-m-xylene)	105		1-mono 165, di 295	258 9 (di)		221 (d1)	į		N,N -Diformyl 182 3
206	2-Bromo-4-nitroaniline	105, yel		129	160					N-Me, 118
207	Triphenylmethylamine	105		207-8	160-2	1		<b> </b>	•	N-Benzyl, 110
208	4-Aminophenanthrene	105		190	224			1	216	
209	2-A minobenzophenone	105-6, pa yel		72,89	80					Oxime (alkali-stable), 156, (acid stable), 127; N Propionyl, 78
	3-Amino-6-phenylpyridine 3-Amino-4-methylpyridine	105–6 106	260	148-9 84	201 81				179 80	Chloroplatinate, 227, Hydrochloride, 180
212	(3-Amino-γ-picoline) 4-Bromophenylhydrazine	106				İ		ĺ		Acetophenone deriv, 112
	4-Aminoacetophenone	106	294	167	205	128	203			Semicarbazone, 250, Oxime, 148
214	2,4-Diaminopyridine	107		1	191-2(di)	}		1		Chloroplatinate, 224
	9-Phenanthrylmethylamine 2-Methyl-5-nitroaniline (4-Nitro- o-toluidine)	107 107		182-5 151	167	172			241	N-Benzal, 104 N-Formyl, 178 9, N-4- Nitrobenzoyl, 214
217	2,5-Diaminopyridine	107-10		290 (di)	230 (di)					•
218	2-Naphthyl phenyl amine	108		93	148, 136		)	1		
219	2-(4-Aminophenyl) ethyl alcohol	108		105	O-mono 59-60, N,O-di 136	93				Hydrochloride, 171
220	5-A minoacenaphthene	108		238 (mono), 122 (di)	210, 199				190 200	N-Formyl, 172, FeCl <sub>3</sub> → bl col
221	4,4'-Diamino-2,2'-dimethylbiphenyl	108 9		281 (275) (di)					225	N,N'-Dibenzal, 172-3
222		109, yel		199					144	
223		109		108						Hydrobromide, 130, dil HBr
	2-Aminobenzamide 1,4-Diamino-2-iodobenzene (2-Iodo- p-phenylenediamine)	109-11 110 5		177 211	214-5 254					
			L	<u> </u>		<u> </u>				L

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

							T			
No	Name	Melting point, "C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	P Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
226	5-Aminoquinoline	110	310	178			203 4			
227	4-Amino-2-nitrostilbene	110 1,	310	192 3			203 4			Hydrochloride, 223
221	4-Annito-2-nitrostribene	dk red		192 3	1					Hydrochioride, 223
228	3 4	110 5		121	141			i	191	Overs 145 N. Formul 97
229	3-Aminocamphor 4-Bromo-2-nitroaniline	1		104	137-8				191	Oxime, 145, N-Formyl, 87
	T .	111, or		139	137-8					N-Me , 102, N-Et , 91
230	3'-A mino-4-methylbenzophenone	111		139	[					Oxime, 146, Hydrochlo-
231	4-Amino-3-methylbenzophenone	112, pa yel		175	158					ride, 198 N-Propionyl, 128
232	2-Aminonaphthalene (β-	112		132	162	102	133	129	195	
	Naphthylamine)						1			
233	β-Aminopropiophenone (1-Amino-	112 4		90-1	104-5		1		164 5	Hydrochloride, 187, Chlo-
	ethyl phenyl ketone)	(unst )			l		l			roplatinate, 205
234	2-Hydroxybenzylaniline	113		93				-		Hydrochloride, 131, Chlo-
				1			•			roplatinate, 184
235	4-Ethoxy-2-nitroaniline (3-Nitro	113, 108,	]	104	]	72	94	]		
	p-phenetidine)	red								
236	5-Bromo-2-hydroxy-3-methyl-	113		N-mono	N-mono	<u> </u>	ļ			
	aniline			119 di	195	<u> </u>	1			
				200						
237	3-Nitroaniline	114		mono 155,	4	136	138	160	143	
				di 76	(di)					
238	6-Aminoquinoline	114		mono 138	169		193			Methiodide, 199
		(anh)	]	di 75			]			
239	cis-2,5-Dimethylpiperazine	114	162		152 (dı)		146-7			N,N'-Dinitroso, 95
							(dı)			
240	3-Amino-2-phenylquinoline	115 6	2233	mono 124	179 80				194 5	Methiodide, 238, Ethio-
		l		di 173						dide, 202
	5-Amino-3-methyl-1-phenylpyrazole	ı	333	110					160 2	Hydrochloride, 199 200
		116		176	.,					N,N-Dimethyl, 92-3
243	5-Bromo-2-hydroxy-4-methyl-	116	ļ	N-mono	N-mono	ļ				
	aniline	ļ		199, di	223					
244	4-Chloro-2-nitroaniline	116-7,		188 104			110			
247	4-Cinoro-2-introannine	yel		104		ŀ	1110			
245	4-Methyl-2-nitroaniline (3-Nitro-	117		99	148	102	146			Hydrochloride, 170 1
243	p-toluidine)	117		,,	140	102	140			Trydrochioride, 170 1
246	5-Amino-2-methylquinoline	117 8		205						N-Cınnamoyl, 257
240	(5-Aminoquinaldine)	(anh ),		203						N-Cimiamoyi, 257
l	(3-Millioquinaiqine)	grnsh					ļ			
247	trans-2,5-Dimethylpiperazine	118	162		228 9 (dı)		225 (dı)			N,N'-Dinitroso, 174
	2,3,4,6-Tetrabromoaniline	118	102	228-9	220 ) (41)	}	223 (41)			1,3,5-Trinitrobenzene add
- 10	2,5,1,0 I citabi o iliganimic	110		220 )			:			comp, 108
249	2-Methoxy-5-nitroaniline (4-Nitro-	118, or -		175 6	160-1		128			N-Me , 87
	o-anisidine)	red							1	,
250	4-Hydroxypyrazole	118			109 (dı)				129	
	2-Amino-5,4'-dimethylazobenzene	118-9,		157	135					N-Carbethoxy, 94
	•	or -red								• • • • • • • • • • • • • • • • • • • •
252	I-Amino-5-nitronaphthalene	119, red		220		183				N-Formyl, 199
	(5-Nitro-1-naphthylamine)									•
253	5-Hydroxy-2,4,6-tribromoaniline	119		O,N,N-			146 7			
				tri 136						
254	1,4-Diaminonaphthalene	120		303 (d1)	mono		mono			
	-				186, di		187 8			
					280					
255	1,9-Diaminofluorene	120		293 (dı)	abt 310				205	
- 1				,	(dı)					
256	2-(ω-Aminoethyl)-indole	120			173 4					N-Benzal, 122
	(2-(2-Indolyl)-ethylamine)									
257	2,2'-Diamino-4,4'-dimethylbi-	120		189 (dı)	170 (di)					N,N'-Diformyl, 185
	phenyl									
					<u> </u>					L

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

					<del></del>					·
No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
258	2,6-Diaminopyridine	121		203 (di)	176 (di)				240	
259	cis-4,4'-Diaminostilbene	121, pa		172 (di)	253 (dı)					
260	4-Aminobenzhydrol	yel 121			145				i	Hydrochloride, 270-3
	3-Amino-6-hydroxyacetophenone	121 110		N-mono		1	}	}		Oxime, 201 Et eth, 60
		yel		165 di	Í	1	ļ			
262	2-Aminotriphenylcarbinol	121		174			}		122 3	
	3-Hydroxyaniline (3-Amino-	122		mono	N-mono	ł	157	156	122 3	
	phenol)			148 di	174	}	Ì			
264	2.4.4 Taibasmanailia	122 119		101	198 204			1		N-Formyl 222
264 265	2,4,6-Tribromoaniline 4-Amıno-2-hydroxyacetophenone	122 3		N-mono		}				N.N-Di Me 120
		(		91		į	İ			
266	1-Aminoisoquinoline	122 3							290 1	Hydrochloride, 233
267	3,4,5-Tribromoaniline	123		255 6	210	<b>{</b>	}			Chloroplatinate, >300
	4,4'-Diamino-2,2 -dimethyl-	123		228 (di)		1			216	
	diphenylmethane						}	,		
269	cis-2,2'-Diaminostilbene	123, 107, red		214-5 (di)	İ		1		155-6	Hydrochloride 230
270	2,4-Dimethyl-5-nitroaniline	123		159	200	149	192			
271	2-Amino-4-nitrobenzaldehyde	124			i					Oxime, 193 Semicarba-
272	4-Aminobenzophenone	124		153	152		}			zone, 390 Anil, 147, red N-Propionyl 139
	7-Amino-8-hydroxyquinoline	124 124, br		N-mono	132				205	(14-110plony: 15)
		'		177						
	2-Amino-5-nitrobiphenyl	125, yel		133	NO.		169		i I	
2/3	3-Hydroxy-4-methoxyaniline (4-Aminoguaiacol)	125 7		N-mono 116 9	N,O-di 162 4					
276	2-Amino-1-nitronaphthalene	126, or -		123	168	156	160			
	(1-Nitro-2-naphthylamine)	yel		147	2.1					N 170
277	4-Aminoazobenzene Hydrazobenzene	126		146 mono 159,	mono					N-propionyl, 170
2.0	11,01420001120110	.20		di 105	126, bz					
	·				di 162					07 212 2 2 4
279	5-Chloro-2-nitroaniline	126 5 gold-		121						N-Me, 107 N,N-Di-Me,
		yel								*/
280	Benzidine	127		317 (d1)	352 (dı)	232 (dı)	243 (dı)	l		
1				199	203 5			ĺ		
281	2-Aminopyrimidine	127 8		(mono)	(mono)	İ		1	237-8	Chloroplatinate, 216
	• •								-	Hydrochloride, 196
282	2-Amino-6-bromonaphthalene	128		192	218			j		
283	(6 Bromo-2-naphthylamine) 5-Bromo-2-hydroxyaniline	128, 88		177 9				j		Me eth , 97 8
200	(2-Amino-4-bromophenol)	120,00		/				}		
284	5-Aminoisoquinoline	128							>200	Methiodide, 228
285	2-Aminovanillin (2-Amino-	128 9		97						Ethiodide, 216 Oxime, 151-2, Phenyl-
20 ,	4-hydroxy-3-methoxybenzalde-	.20 /	ļ		ļ			\	ļ	hydrazone, 165
ļ	hvde)		l							
286	2-Amino-3,7-dimethylnaphthalene	129, 134	1	231	1					Hydrochloride, 275
287	(3 7-Dimethyl-2-naphthylamine) 4-Methoxy-2-nitroaniline	129, 123,		117, yel	140					N-4-Nitrobenzoyl, 204
1	(3-Nitro-p-anisidine)	dk red		-		}				•
288	2-Aminotriphenylmethane	129		154 5		ŀ				N-Me, 130-2
							السياسيل			

<sup>\*</sup>Derivative data given in order im p | crystal color, solvent from which crystallized

### 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, *C	Acetamide	Benzamide	Benzene sulfon amide	p Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
289	2-Aminoquinoline	129							255-6	Methiodide, 247, Ethiodide, 232, 1,3,5-Trinitrobenzene add comp, 186, red
290	4,4'-Diamino-3,3'-dimethyl- biphenyl (o-Tolidine)	129		mono 103 (hyd), di 315 tetra 211	198 (mono), 265 (dt)					N,N'-Diformyl, 254  1 Naphthylthiourea, 167, 3-Nitrophthalimide, 185
291	2,4-Diaminodiphenylamine	130		188 (dı)	2-mono 213					
292 293	<b>3-Aminocoumarin 2-Methyl-4-nitroaniline</b> (5-Nitro-o-toluidine)	130, yel 130		201 2 202	173	158	174			1-Naphthylthiourea 165
294	2-Amino-4-chloropyridine	130 1		115-6	mono 120; di 165				243	
295	4-Hydroxy-3-nitroaniline	131, 127, red		N-mono 157 8	<b>u.</b> 103					N-Me, 113 Et eth, 40
296 297	4-Bromo-3-nitroaniline 2-Aminobenzothiazole	131 2 132, 129		146 186	186				256	N,N -D1-Me , 72
298	2-Amino-4-methylquinoline	133	320	160	100				abt 250	N-Phenyl, 129, Chloro- platinate, 230
299	2,2'-Diaminobenzophenone	133, pa yel		168 (154) (d1)					164	
	2,2'-Diaminoazobenzene	134, red		271 (dı)						
301	3,5-Dimethyl-2-hydroxyaniline	134–5		N-mono 96	(O,N-di)					N-Formyl, 68
302	2-Hydroxy-5-methylaniline (4-Hydroxy- <i>m</i> -toluidine)	135		N-mono 160, N,O-di	N-mono 191, N,O-di					N-Propionyl, 95 6, N,O-Dipropionyl, 91 2
303	3-Methyl-4-nitroaniline (6-Nitro- m-toluidine)	135		145 102	190					2-Naphthylthiourea, 159
304	2-Amino-3-methylnaphthalene (3-Methyl-2-naphthylamine)	135		181-2	190					
305	2-Aminoacenaphthene	135							260, yel, eth	Hydrochloride, 270
306	DL-2,2'-Diamino-6,6'-dimethyl- biphenyl	136		205 (dı)	182 (dı)		162 3 (d1)		Cin	
307	1,4-Diamino-2-nitrobenzene (2-Nitro-p-phenylenediamine)	137, blk		1-mono 162, 4- mono 189, di 186	4-mono 236					1,4-D1-4-nitrobenzoyl, >305
308	9-Aminophenanthrene	137 8, 104		207 8	199				190	
309	4,4'-Diamino-3,3'-dimethoxy- biphenyl (Dianisidine)	137-8		242 (dı)	236 (dı)				225(dı)	
310	3,5-Dimethyl-4-hydroxyaniline (5-Amino-2-hydroxy-m-xylene)	137-8		160 (di)						Me eth, 66
	2,6-Dinitroaniline	138		197	224					Mathiadida 220 NI M 02
	2-(4-Aminophenyl)-quinoline  2-Amino-3,6-dimethylnaphthalene	138		mono 189, di 154 207	234					Methiodide, 220, N-Me, 82, N-Formyl, 160 Hydrochloride, 283
	(3,6-Dimethyl-2-naphthylamine)  2-Methoxy-4-nitroaniline	139–40,		153-4	150	181	175, 170			
	(5-Nitro-o-anisidine)	pa yel								
	4-Aminopropiophenone	140		161	190					Oxime, 153
316	4-Amino-3-nitrobenzophenone	140, 135, yel			154 5					N,N-Di-Me , 116, N-Et ,
		yeı								

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	P- Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
317	2-Amino-4-methyldiphenylamine	140			161					Hydrochloride, 200
	1,4-Diaminobenzene (p-Phenylene- diamine)	140, 147	267	mono 162 3 di 304	mono 128 di 300	247 (di)	266 (dı)			3,5 Dinitrobenzoate, 178
319	2-Hydroxy-5-nitroaniline	142 3	}	u 301	>200	Ì	122 (O-)			Me eth 118 Et eth, 99
		(anh ) 80-90 (hyd ), or		220						
320	2-Amino-4-nitrostilbene	142 3, red		N-mono 220 yel, al						Hydrochloride, 219
321	5-Amino-8-hydroxyqumolme	143		N-mono 221 2, al, N,O- di 206 7,	205 (O, N-dı)					Me eth , 156, yel
222	1 Amina 2 pitzananhthalana	144 mod		al 199	175					N Et 77 and
	1-Amino-2-nitronaphthalene (2-Nitro-1-naphthylamine)	144, red- yel			175			ľ		N-Et,77, red
323	2-Amino-5-nitronaphthalene (5-Nitro-2-naphthylamine)	144, red		186	182					
324	5-Hydroxy-2-methylaniline (4-Hydroxy-o-toluidine)	144		N-mono 178 N,O-di		183 (N-)				
325	2,5-Dimethyl-4-nitroaniline (5-Nitro-p-2-xylidine)	144-5		128 168-9		162	185			
	4-Amino-4'-bromobiphenyl	145		247			174			
327	1-Aminophenanthrene	146		220					204	
	3,5-Dihydroxyaniline (5-Amino- resorcinol) 4-Amino-2-chlorobenzaldehyde	146-52 147, yel		( <i>tri</i> ) 152						Di Me eth, 46 Picrate of Di-Me eth, 167-70 N,N'-Di-Me, 82, N-Et,
330	4-Nitroaniline	147 8,		215	199, 203	139	191		100	101 1-Naphthylthiourea, 187
331	5-Amino-3-methyl-1,2,4-triazole	yel 148		>270	(d1) 285 90				225	
1	2,2'-Dihydroxyhydrazobenzene	148		/2/0	186 (d1)				223	Di-Me eth, 102
	7-Amino-2-methylquinoline	148 (anh )			172 3				213-4	
334	4,4'-Diamino-2,2'-dimethyl azoxybenzene	148, gold- yel		281 (dı)	290					
335	4-Bromo-3-hydroxyaniline	150		210-2			135-6 (O-)			
336	3-Amino-1-phenyl-1,2,4-triazole	150		3-mono 168, 3,3- di 118		!	(0-)		220	Hydrochloride, 187
337	4-Aminochalcone (4-Aminobenzal-	151,		179						Oxime, 139
338	acetophenone) 4-Aminopyrimidine	golden 151-2		202		٠,			226	N-Me, 74-5, N-Phenyl,
339	Pentamethylaniline	151-2	277-8	213						142-3 N-Formyl, 217, N-Me, 60, N,N-D1-Me, 53-4
- 1	N-Methyl-4-nitroaniline 5-Bromo-2-nitroaniline	152 152, red-		153 139	112	121				N-Me, 115, N-Et, 90
342	3-Chloro-4-hydroxyaniline	yel 153		N-mono 144, di 124			116-7 (O-)			Me eth, 62

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, *C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
343	4-Chloro-2-hydroxyaniline	154		140 (dı)						Hydrochloride, 226 7, Benzyl eth , 46 7 Me eth , 52
344	4-Aminoquinoline (γ-Amino-	154	ŧ	178			į		274	Methiodide, 224, Ethio-
	quinoline)	(anh )								dide, 232
	3-Aminobenzopyrazole	154		177 8 (di)	182 (di)					Di Me eth . 158
346	2,5-Dihydroxy-4-nitroaniline (2-Amino-5 nitrohydroquinone)	154, red		mono 226 di 183 4						Di Me eth , 136
347	4-Hydroxy-2-nitroaniline	154, red		N-mono 218 N O-di						Me eth , 129 123
348	3-Aminotriphenylcarbinol	155		146 164						O,N,N-Trimethyl, 81
349		156		205 (di)	172 (dı)					O,IN,IN-171IIIetilyi, 81
350	3,3'-Diaminoazobenzene	156 140,	}	272 (dı)	286 (dı)					
		or -yel							176	CII . I
351   352	5-Amino-1-phenyl-1,2,4-triazole 4-Nitrophenylhydrazine	157 157, or -		205	193				175 119 20	Chloroplatinate, 197
332	4-Mitrophenymydrazine	red		203	193				119 20	
353	<b>4-Aminopyridine</b> (γ-Amino pyridine)	158		150 (anh )	202				215 6	
354	4,4'-Diamino-3,3'-dimethyl- diphenylmethane	158 9		224 (di) 119	215 (di)				192-3	
255	2-Amino-8-nitroquinoline	159	1	( <i>tetra</i> ) 211	166				257	
356	3-Amino-1,2,4-triazole	159	l	1	100			1	231	Hydrochloride, 153
357	2-Amino-4'-nitrobiphenyl	159, or - red		199			163		20.	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	3-Amino-2-methylquinoline -1-Amino-4-hydroxy-3-nitro-	159 60 160, ma-	270	165 250, 238	161 3 <b>3</b> 0				235	N-Formyl, 163
	naphthalene (4-Hydroxy-3-nitro-1-	roon								
60	naphthylamine) 2,4-Dihydroxy-5-nitroaniline	160-1, red		N- <i>mono</i> 261 <i>tri</i> 176						Di-Me eth , 136 7
361	1,3-Diamino-4-nitrobenzene (4-Nitro-m-phenylenediamine)	161 157, yel red		1-mono 200 1,3-	222 (di)		169 ( <i>dı</i> )			N,N,N',N'-Tetramethyl, 81
162	3-Hydroxy-4-methylaniline	161		di 246 N-mono			111-2			N-Chloroacetyl, 154 5
,02	(2-Hydroxy- <i>p</i> -toluidine)	101		225 di 132 3			(O-)			iv-emoroacety1, 134 3
363	2-Hydroxy-4-methylaniline (3-Hydroxy-p-toluidine)	162		N- <i>mono</i> 171	N-mono 169, N,O-di 162					
	4-Aminoacetanilide 3-Hydroxy-4-nitroaniline	162 162, 158, or -yel		304 N-mono 221,						Me eth , 169, 161
66	2,4-Dimethyl-6-hydroxyaniline	163		N,O-di 149 mono 186 7,	N-mono 211,					Me eth , 150
Ì		,		di 87 8	N,O-dı					
867	2-A minofluorenone	163, vlt -		227	148 9					Hydrazone, 209, N-Car-
168	1-(2-Aminoethyl)-4-hydroxybenzene	red 164			N-mono				206	bethoxy, 167 8
00	(4-(2-Aminoethyl)phenol,	104			162, di				200	
	Tyramine)				172					

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

No	Name	Melting point °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon- amide	Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
369	4-Aminophenacyl alcohol	165, yel		N-mono 176 7, O- mono 130 N,O-di 162	188 (O-)					Phenylhydrazone, 199
370	3-Bromo-4-hydroxyaniline	165 155, pa br		N-mono 157	N-mono 184 5, di 192					
371	2,7-Diaminonaphthalene	166		261 (dı)	267 (d1)				210 (d1)	
372	4-Amino-4'-iodobiphenyl	166-7, 159 yel						,	(4.)	N-Benzal, 209, N-Pipero- nylidine, 150 1, Hydro- chloride, 295
373	4-Amino-3-nitrobiphenyl	167, red		132	143		,			N-Me, 112
374	1,2-Diamino-4-hydroxybenzene (3,4-Diaminophenol)	167-8	i	1,2-di 205 7	1,2-di 203 tri 225					
375	4,4'-Diaminotriphenylcarbinol	168 s h , 175 r h		4,4'-di 267						Me eth, 162
376	4-Amino-2-phenylquinoline	168		108, 117 (d1)	182					Methiodide, 274, Ethio- dide, 244, N-Formyl, 275
377	2,6-Dinitro-4-methylaniline	168, 172		195	186					
378	4-Amino-2-methylquinoline	168	333			į		i	197 9	N-Phenyl, 150, Chloro- platinate, 223
379	6-Aminocoumarin	168-70, yel		216-7	173	159				N-Formyl, 175-6
380	Picramic acid (3,5-Dinitro-2- hydroxyaniline)	169, red		N-mono 201, O- 193	N-mono 300 O- 218		191			
	3,3 -Diaminobenzophenone 4,5-Dimethyl-2-hydroxyaniline	173, yel 173 5		226-7 (d1)   N-mono   191,   N,O-d1   157	N-mono 195 6, N,O-di 152 3					Oxime, 177-8
383	2-Hydroxyaniline	174		mono 209 201, di 124	N-mono 165 O- 185	141	146			
384	4-Hydroxy-3-methylaniline	175		N-mono 179	N,O-di 194		109-10 (O-)			
385	6-Amino-5,7-dimethylquinoline	175	>300	212		1	( , ,		182	
	4,4'-Diaminodiphenyl sulfone	175-6		286 (d1)						N,N'-D1-Me , 179-80, N,N-Tetramethyl, 260
387	trans-2,2'-Diaminostilbene	176, 168, gold- yel		304 (dt)					209	Hydrochloride, 267
388	6-Amino-5-nitroquinoline	178, 174, yel					168		270	
389	6-Aminothymol	178 9		N-mono 74, tri 91	N-mono 178-9, N,O-di 166 7					Oxid → thymoquinone, 45 5
390	4-Hydroxy-2-methylaniline (5-Hydroxy-o-toluidine)	179		N-mono 130	92 (O-)					Hydrochloride, 215
391	2,4-Dinitroaniline	180, 188		120	202, 220		219			
	1-Amino-4-chloroanthraquinone	180, red		203-4	,					N,N-D1-Me , 172
	2,6-Dimethyl-4-hydroxyaniline	181		178-80						N-Benzal, 104-5, N-Me, 43, N-Et, 161-2
	4-Amino-2,6-dimethylpyrimidine 4-Aminobenzamide	183 183, yel		275					214	N-Phenyl, 104 N-Chloroacetyl, 241 3

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, *C	Acetamide	Benzamide	Benzene sulfon- amide	Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
396	4-Hydroxyaniline (4-Aminophenol)	184, 186		150 (di), 168 (mono)	N-mono 216-7, N,O-di 234	125	N-mono 252-4, O- 142	150		3,5-Dinitrobenzoate, 178
397	1-Amino-3-hydroxynaphthalene (3-Hydroxy-1-naphthylamine)	185		N-mono 179	309 (O,N- dt)		137 (O-)			
	5-Hydroxy-2-nitroaniline	185 6, or	420	N-mono 266	106 (4)					Me eth, 131, br, Et eth, 105, yel
	6,6'-Diamino-3,3'-dimethyl triphenylmethane	185-6	430, part d	217 (dı)	196 (d1)					
400 401	4-Amino-2,6-dimethylpyridine 4-Amino-4'-hydroxyazobenzene	186 186	246	113 N-mono 203 di 236 7					194 5	Chloroplatinate, 250 N,N-Di-Me, 203
402	4-Amıno-4'-methylbenzophenone	186 7	[	155						Phenylhydrazone, 163
403 404	6-Amino-2-methylquinoline 4-Amino-2,6-diethyl-5-methyl- pyrimidine (Cyanethine)	187-8 189	280 d	168 9 59						N-Cinnamoyl, 257
405	2,4,6-Trinitroaniline (Picramide)	190	İ	230	196	211				
406	1-Amino-6-hydroxynaphthalene (6-Hydroxy-1-naphthylamine)	190 185		N-mono 218, N,O-di 187	N-mono 152 N,O-di 223				170	
407	4,4'-Diaminoazoxybenzene	190, yel		275						Sn + HCl → 1,4-Diamino- benzene, 147
408	4-Amıno-3-nitrobenzaldehyde	191, yel		155						Phenylhydrazone, 202, Oxime, 207 4-Nitrophenylhydrazone, 270-2
	2-Amino-1,5-dinitronaphthalene (1,5-Dinitro-2 naphthylamine)	191		201			182			P
410 411	DL-2,2'-Diamino-1,1'-dinaphthyl 8-Amino-6-nitroquinoline	193 194, red		235 6 (di) 224	235 (dı)				185	Chloroplatinate, 180,
412	1-A mino-4-nitronaphthalene (4- Nitro-1-naphthylamine)	195		190	224	173, 158	185			Methiodide, 176
413	2-Amino-4,6-dimethylpyrimidine	197							230	Hydrochloride, 181, Chloroplatinate, 225, N-Me, 98
414	4,6-Diamino-2-methylquinoline	197		6- <i>mono</i> 250						6-N-Cinnamoyl, 253-4, 4-N-Et, 195, 6-N-Et, 232
415	1,2-Diamino-4-nitrobenzene (4- Nitro-o-phenylenediamine)	198, red		1 mono 205 2 mono 195	235 (di)					N,N'-Di-Me , 172
416	2,4-Dinitrophenylhydrazine	199 200		197 8	206-7					
-	2-Hydroxy-5-methyl-4-nitroaniline	200, yel 200, yel		N-mono 242					197 8	Me eth, 132, N-Acetyl of Me eth, 156 Hydrochloride, 258-9,
	4-Amino-3-nitropyridine 4-Amino-4'-nitrobiphenyl	200, yei		264, 240,		174, yel			17/ 6	Chloroplatinate, 256
				yel		174, 301	101.3			Overso 202 N.N.D. Ma
ļ	2-Amino-5-nitrobenzaldehyde	200, yel	l	160-1			181-2			Oxime, 203 N,N-Di-Me 105, yel
421	2-Amino-7-hydroxynaphthalene (7-Hydroxy-2-naphthylamine)	201		N-mono 232, N,O-di 156	N-mono 243 6, N,O-di 181					
422	2-A mino-1-bromo-3-methylanthra- quinone	202, 204			di 243 4, pa yel, al	j				

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point *C	Boiling point *C	Acetamide	Benzamide	Benzene sulfon amide	P- Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
423	4,4'-Diamino-1,1'-dinaphthyl	202		363 (di)	320 (di)	-			147	
_	4,4',4"-Triaminotriphenylmethane	203		201 ( <i>tri</i> )	320 (u.)		i   		147	1,3,5-Trinitrobenzene add comp, 140, blk Oxime, 201 2
426	3-Amino-5-phenylacridine	204		256	246		1			Oxime, 201 2
	2-Amino-1,4-naphthoquinone	204 5,		202	1240		l .			N-Phenyl, 191
`~'	2 / map / ma	or -red		1202			·			1.4 Thomys, 191
428	1-A mino-2-methylanthraquinone	205, red	i	mono 176 7, di 203-6			218			
429	4,4',4"-Triaminotriphenylcarbinol (Pararosanılıne)	205		192 (tri)						Me eth, 135
430	1-Amino-7-hydroxynaphthalene (7-Hydroxy-1-naphthylamine)	205 7		N-mono 165	N-mono 208-9, N,O-di 208			i		
431	4,6-Diaminoisophthaladehyde	208		270 (mono), 280 (d1)						Dioxime, 220, Diphenyl- hydrazone, 337
432	N-4-Hydroxybenzylaniline	208			İ		ļ			Me eth, 65, Et eth, 65
433	6-Aminobenzopyrazole	210		248 (6-N-), 184-5 (di)					i	Dihydrochloride, 230
434	4,4'-Diamino-2,5,2',5 -tetra-	210		217 (dı)	250 (d1)		i i			•
- 1	methyltriphenylmethane	1						1	ı	
435	3-Indolylpyruvic acid	211, grey							İ	4-Nitrophenylhydrazone, 153-4, Oxime, abt 175
436	2-Amino-6-hydroxynaphthalene (6-Hydroxy-2-naphthylamine)	212 3			N,O-di 228 30					Me eth, 78 Et eth, 91
437	5-Amino-1,4-dihydroxyanthra-	212 3,			}			}		N-Phenyl, 223, Di-Me
	quinone (5-Aminoquinizarin)	br red					]	- 1		eth , 242-3
	2-Amino-4,5-dimethylpyrimidine	214 5				Ì	1	1	250	Chloroplatinate, 227
439	5-Bromo-4-hydroxy-2-methyl- aniline	215, 205		171 2(dı)	229 (dı)					
440	4-Amino-4'-nitroazobenzene	216 205		245						N-Me, 206 7, bl
141	2-Hydroxy-6-nitroaniline	216, red		N-mono 172			136 (O-)			Me eth, 76
142	3,4-Diaminopyridine	218 9			222 3 (di)	- [		l	235-7	Chloroplatinate, 231
- 1	1-Amino-5-chloroanthraquinone	219, red		219	218	İ	1			
	3,6-Dimethylcarbazole	219		129		- 1	1	- 1	192	N-Nitroso, 106
145	3-Aminothioxanthone	221-2, yel -br		236 7					i	Hydrochloride, 230
146	2-Amino-10-hydroxyphenanthrene	221		182 (O, N-d1)	225 (O, N-dı)					
147	5-Amino-4-nitroacenaphthene	222, red		252	233	-	l	- 1	ļ	N-Formyl, 227
148	5-Chloro-4-hydroxy-2-methyl- aniline	223 5, 204 5		162 (dı)	220 (dı)					
149	2,6-Dimethylcarbazole	224				}	}	1	162	N-Nitroso, 113
	2-Amino-1,8-dinitronaphthalene (1,8-Dinitro-2-naphthylamine)	226		238			221	ļ		,
151	trans-4,4'-Diaminostilbene	231, yel		353 (dı)	352 (d1)	ĺ	l	j	1	
	2-Amino-3-hydroxynaphthalene	234	ł	188	N-mono	ţ	ļ	- !		
153	(3-Hydroxy-2-naphthylamine) 1-Amino-2,4-dinitronaphthalene	242		(O,N-d1) 259	233-5 252		166			
	(2,4-Dinitro-1-naphthylamine)			:		İ	l	1	ı	
	2,5-Dimethyl-4-hydroxyaniline	242		177-9		l	227	l	į	Et eth, 69 70
- 1	1-Amino-3-bromoanthraquinone	243, red 244		214 237 (dr)			227	- 1	İ	Dhanulhudeanaa 240
- 1	4,4'-Diaminobenzophenone Carbazole	244		. ,	98	i	ŀ	ļ	185	Phenylhydrazone, 240
- 1	1-Amino-2-hydroxyanthraquinone	250, br	]	N-mono	<b>1</b> 0	1	1	1	105	Et eth, 182, red
	· ····································	200,01	1					i i		L. COI , 104, ICU

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, *C	Boiling point, *C	Acetamide	Benzamide	Benzene sulfon- amide	p- Toluene sulfon- amide	Phenyl thiourea	Picrate	Miscellaneous
459	1-Aminoanthraquinone	252, 243		218	255		228 9			
460	3-Aminocarbazole	254		3-mono 217, di 200, tri 175	3-mono 250					
461	2,7-Diaminocarbazole	260		320 (di)	1			1		N,N'-Dibenzal, 290
462	1,8-Diaminoanthraquinone	262, red		284 (di)	324 (di)					, ,
463	1,4-Diaminoanthraquinone	268, vlt		271 (di)	284 (di), 280 (mono)					
464	2-Amino-3-nitrofluorenone	200 1		245 6	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					N. C. J. d 204
- 1	1,1'-Diamino-2,2'-dinaphthyl	269, vlt 1 281		243 6  230(di)	278 (dı)					N-Carbethoxy, 204
1		290, red		283 (di)	325 (di)	]	İ			
	1,7-Diaminoanthraquinone 2,7-Diaminofluorenone	290, red 290, vlt		$\frac{283(ai)}{222(di)}$	323 (at)	ĺ	Ì		220 (4.)	Oxime, 255, Phenylhydra-
407	2,7-Diaminonuorenone	290, VII		222 (at)					230 (ai)	zone, 230, 4-Nitrophenyl- hydrazone, 280
468	1,6-Diaminoanthraquinone	292, red		295 (di)	275 (di)		į			
469	1-Amino-5-nitroanthraquinone	293, red		275	237					N-Me, 250 2, vit- blk, N-Et, 238
470	1-Amino-4-nitroanthraquinone	296, yel - red		256 8						N-Me , 250
471	5,8-Diaminoquinizarin (1,4-	>300,		5,8-dı	ļ	5,8-di	İ	ł		
	Diamino-5,8-dihydroxyanthra- quinone)	br -vlt		284		275				•
472	2-Aminoanthraquinone	305 8, 302		mono 262, di 258	228	271	304			
473	2-Amino-3-bromoanthraquinone	307, or -yel		259 217	279					N-Benzal, 174
474	<b>2-Aminoquinizarin</b> (2-Amino-1,4-dihydroxyanthraquinone)	313 4, grn -yel								N-Phenyl, 255 6, N-4-Tolyl, 220
175	1,5-Diaminoanthraquinone	319, red		317 (di)	> 350 (di)					
	2,7-Diaminoanthraquinone	>330, or		>350	300 (di)					
	2,5-Dianilino-1,4-benzoquinone	345, red-br			, (u.,					Anil, 203, Dianil, 240, red
		>350		i	>250 (di)	1	1	l		N,N'-Dibenzal, 370

<sup>\*</sup>Derivative data given in order mp crystal color, solvent from which crystallized

## TABLE XVIII. ORGANIC DERIVATIVES OF AMINES 2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Methyl p-toluene sulfonate	Methio dide	Picrate	Chloro platinate	Miscellaneous
1	Trimethylamine	3			0 6709		230	216, 225		p-Toluenesulfonate salt,
2	Dimethyl ethyl amine	37 5						193		Hydrochloride, 221
3	N-Methylpyrrolidine	78 80						221	233	
4	Triethylamine	89		1 40020	0 725545			173		2,4-Dinitrobenzoate salt, 81 3, β-Resorcylic acid salt, 120
5	1,2-Dimethylpyrrolidine	96	]	1 425220	0 799420		]	235	223	
6	1,3-Dimethylpyrrolidine	96-7			0 792‡5			dimor- phous, 181 or 110-5	58 9	HgCl₂ add comp , 200
7	Pyridine	116		1 509221	0 97845	139	117	167	241, 262 4	p-Toluenesulfonate salt, 160, Ethiodide, 91
8	1,2,5-Trimethylpyrrolidine	116	ļ	1 4335 <sub>α</sub> <sup>2</sup>	0 8154		310	163	ļ	
9	2-Dimethylaminodiethyl ether	121	i	1 40620	0 80620		160 5	119-21		1
10	Dimethylaminoacetone	123		ļ <u>-</u>					176, s h	Oxime, 99
11	1-Methylpyrazole	127	1	1 4787He	0 9934	1	190	148	196 8	
- 1	N-Ethylpiperidine	128		1 4416 <sup>20</sup> 1 503 <sup>17</sup>	0 823740	150	1220	167 5	202	T-1
13	2-Methylpyridine ( $\alpha$ -Picoline) $\beta$ -Dimethylaminoethyl alcohol	135		1 4320	0 949715	130	230	169 96 7	216, 195	p-Toluenesulfonate salt, 161, Ethiodide, 123
14	(2-Dimethylaminoethyl alcohol)	133		1 43	0 0000			90 /		
15	1,3-Dimethylpyrazole	136		1 467½	0 962815	Ì	256	138		
	2-Methylpyrazine	136-7	-	· · · · · ·	1 02940		129 30	133		
17	4-Methylpyrimidine	141 2	1		1 031 18	1	l	131 4		HgCl <sub>2</sub> double salt, 198
18	2,6-Dimethylpyridine (2,6- Lutidine)	142 3					233	168	208	
19	<b>3-Methylpyridine</b> (β-Picoline)	143		1 50424	0 951525			150	202	Styphnate, 154, Oxid  → nicotinic acid, 228
20	4-Methylpyridine (γ-Picoline)	143	}	1 50619	0 95745			167	231	β-Resorcylic acid salt, 125
	4-Chloropyridine	147 8					ŀ		202	
	2-Ethylpyridine	149	Ì		0 9371 17	]	Ì	187 9	165 7	
4	3-Chloropyridine	149						135	168	D.1 1.1 220
1	Tri-n-propylamine	156 5	İ	1 417620	0 75340	<b>,</b>	207 8	116	216	Ethiodide, 238
25	2,4-Dimethylpyridine (2,4- Lutidine)	157, 159		1 50314	0 927345			183	216	β-Resorcylic acid salt,
26	2,5-Dimethylpyridine (2,5- Lutidine)	160				•	<u> </u> 	169	192 4	143
27	1,3,4-Trimethylpyrazole	160		1 404418	0 95618			164		
	3-Ethylpyridine	162-4		1 4866He	0 9540			128-30	208-9, 196	
29	β-Diethylaminoethyl alcohol (2- Diethylaminoethyl alcohol)	163		1 44025	0 8601 25					4-Nitrophenylurethane,
30	Tropidine (2-Tropene)	163		I 4884 <sup>19</sup>	0 95320	ļ	abt 300	285	217	
	2,3-Dimethylpyridine (2,3- Lutidine)	164		u u				188	195	
32	3,4-Dimethylpyridine (3,4-Lutidine)	164						163	205	
33	4-Ethylpyridine	164-5			0 941720	ĺ		168	213	
	2,4,5-Triethylpyridine (2,4,5-Collidine)	165-8						128-31	205	
35	1,4-Bis-dimethylaminobutane	167						199	Ì	
	Tropane	167			0 93140	1	>300	281	230	
37	1-Diethylaminoisopropyl alcohol	167 72			0 851120			89	i	
38	2-Chloropyridine	170, 166	[		1 20515	120				
39	3-Bromopyridine	170	[	1 569420	1 6454	156	165		175	
40	3,5-Dimethylpyridine (3,5-	170-1			1	1		245	255	
- 1	Lutidine)							1	{	

<sup>\*</sup>Derivative data given in order. m p, crystal color, solvent from which crystallized

# TABLE XVIII. ORGANIC DERIVATIVES OF AMINES 2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

<b>l</b> o	Name	Boiling point,	Melting point,	n <sub>D</sub>	Density g/ml	Methyl p toluene	Methio- dide	Picrate	Chloro platinate	Miscellaneous
		°C	,c		<del>-</del>	sulfonate	dide		ļ	
41	2,4,6-Trimethylpyridine (2,4,6-Collidine)	172			0 91720			156	223	
42	1,4,5-Triethylpyrazole	176-7		1 4848#e	0 9685 48			175 6		1
43	2,3,6-Trimethylpyridine	176 8						146	250 2	
	(2,3,6-Collidine)									
44	Benzyl dimethyl amıne	181	1					93	192	Picrolonate, 151
45	2,3,5-Trimethylpyridine	184	1		ł	l	1	183, 179	227 8	
	(2,3,5-Collidine)					1			ł	
46	N,N,2-Trimethylanıline (N,N-Dimethyl o-toluidine)	185	İ	1 51520	0 928640			122, 116		1,3,5-Trinitrobenzene add comp, 113
47	2,6-Dimethyl-4-ethylpyridine	186			0 916			119-20	210	add comp, 115
	2,4-Diethylpyridine	187-8			0 93380			98 100	170-1	
	3-Diethylaminopropyl alcohol	190			10 /350		175	70 100	.,, ,	
	Methyl 2-pyridyl ketone	192					161	131	220	Oxime, 121 Phenylhy-
ļ							j			drazone, 155, Ethio- dide, 205
51	2,3,4-Trimethylpyridine	192-3			0 91215			163 4	259	dide, 203
	(2,3,4-Collidine)							ĺ		
52	N,N-Dimethylaniline	193	2 2 5	1 558220	0 955740	161	228, 220	163	173	p-Toluenesulfonate sal 133, 3,5-Dinitroben-
										zoate salt, 115
53	2-Bromopyridine	194			1 65715	127				
	3-Ethyl-4-methylpyridine	195 6			0 9656°			148 50	234, 205	
	3,5-Dimethyl-2-ethylpyridine	198	1			1		152	189	
56	N,N,2,6-Tetramethylaniline	199-200	1	1 51320	0 91240	}			l	1,3,5-Trinitrobenzene
	(N,N-Dimethyl-m-2-xylidine 2-Dimethylamino-m-xylene)									add comp, 108
	2-Dimentylanino-m-xylene)				1				ļ	
- 1	N-Ethyl-N-methylandine	201			0 91945		125	134 5		Hydrochloride, 114
58	N,N,2,5-Tetramethyl-	204						158	196	
	aniline (N,N-Dimethyl-p-2-									
i	xylidine, 2-Dimethylamino-									
اءء	p-xylene)	205		1 620120	0.016430			122.4	210	
39	N,N,2,4-Tetramethyl-	205	1	1 520120	0 916420			123 4	219	1,3,5-Trinitrobenzene
	aniline (N,N Dimethyl-m-4-									add comp,114
- 1	xylidine, 4-Dimethylamino- m-xylene)									
60	N,N-Diethyl-2-methylaniline	206, 210					224	180		
٠,	(N,N-Diethyl-o-toluidine)	200, 210					227	160		
61	2-Chloro-N,N-dimethylaniline	207					152	132		
	N,N,4-Trimethylaniline	210		1 53620	0 92920	85	219	129		1,3,5-Trinitrobenzene
1	(N,N-Dimethyl-p-toluidine)				1					add comp, 124, vlt
63	3,4-Diethylpyridine	211						139	221	, ,
64	Tri-n-butylamine	211, 216			0 77828		180	106		β-Resorcylic acid salt,
65	N,N,3-Trimethylaniline	212		1 549220	0 94120		177			121
"	(N,N-Dimethyl-m-toluidine)	212		1 3492**	0 9414		1//			
66	Methyl 4-pyridyl ketone	212-4						130	205	Oxime, 142, Phenyl-
		1								hydrazone, 150, HgC
67	N,N-Diethylaniline	218, 216			0 935120		102	142		double salt, 183-4
- 1	Methyl 3-pyridyl ketone	220	1		0 9331		102	142		O 122 Ph1
00	wietnyi 3-pyridyi ketone	220	1 1		1			1		Oxime, 133, Phenyl- hydrazone, 137, HgC
		}								double salt, 158
69	N,N-Diethyl-4-methylaniline	229			0 92416		184			
	(N,N-Diethyl-p-toluidine)						ĺ			
	2,3,4,5-Tetramethylpyridine	232 4						170 2	210	
71	Quinoline	239	-156	1 626820	1 092940	126	133	203	227, 218	p-Toluenesulfonate sal
			] İ							155, Ethiodide, 159,
_ [	Y				1					Styphnate, 207 8
	Isoquinoline	243	26, 24	1 61520,	1 098620	163 l	159	222	263	Ethiodide, 148

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XVIII. ORGANIC DERIVATIVES OF AMINES 2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

<u> </u>	No	Boiling	Melting		Density	Methyl	Methio-	D	Chloro	Name II
No ——	Name	point, °C	point, °C	n <sub>D</sub>	g/ml	p-toluene sulfonate	dide	Picrate	platinate	Miscellaneous
73	DL-Nicotine (DL-1-Methyl-2- (3-pyridyl)-pyrrolidine)	243			1 00820		219	218	abt 280	
74	2-Dimethylaminobenzaldehyde	244, yel					164		205 6	Oxime, 87, p-Nitro- phenylhydrazone, 191
75	Tri-isoamyłamine	245, 237			0 78640			125		
76	N,N-Dipropylaniline	245			0 910420	•	156	261		
77	<b>2-Ethylquinoline</b> ( $lpha$ -Ethylquinoline)	245-6		1 59823	1 05017	}	180	148	188	
	2-Methylquinoxaline	245-7	1			İ	1	215	>250	
79	1-Methylindole	247, 239 247	1	1 612620	1 07070	161, 134	105	150 191, 195	228	Pasaraulia aaid salt
	2-Methylquinoline (Quinaldine)					161, 134	195		220	β-Resorcylic acid salt, 145 Ethiodide, 233
	8-Methylquinoline L-Nicotine (L-1-Methyl-2-(3-	248 248		1 616 <sup>20</sup> 1 528 <sup>20</sup>	1 07241			200	275	$[\alpha]_{D}^{20} - 167-8$
02	pyridyl)-pyrrolidine)	240		1 328	1 00974			210	1273	[a]b = 107-6
83	1-Ethylisoquinoline	250						207 10	200	
84	2,4-Dimethyl-5,6,7,8-tetrahydro-	250	20	1 541520	1 004340		157	144		Hydrochloride, 195
	quinoline									
86	N-Methyl-2-pyridone	255	į .					145	141	Styphnate, 162
87	4,6-Dimethylquinoline	255 6,					ļ	236-7	238	*'
		280								
88	3-Ethylisoquinoline	257						171 2	180	
89	Tri-n-amylamine (Tri-n-pentyl- amine)	257, 245				80				
90	3-Methylquinoline (β-Methyl-	257 9	16 7	1 617120	1 067320		221	187	  249	Ethiodide 220
70	quinoline)				,					
	6-Methylquinoline	258		i 6157 <sup>20</sup>	1 065440	154	219, 216	229		
92	3-Chloroquinoline (β-Chloro-	258 60					276 subl	182	>300	
	quinoline)	250	ļ., l					125		
	3-Bromo-N,N-dimethylaniline 5-Methylquinoline	259 260	11 				105	135 210 3		
- 1	4-Methylquinoline (γ-Methyl-	261-3			1 086220		173 4	210-1	226 30	Ethiodide, 141 3
	quinoline)									
96	2,4-Dimethylquinoline	264-5			1 06115		263 5	193-4	229	Ethiodide, 214
	2-Phenylpyridine	268-9				<b>(</b>		175	204	
1	6,8-Dimethylquinoline	269		!	1 066⁴	- 0.0		288-9	235	
	N,N-Di-n-butylaniline	271	i	'		180	140	125	204	
100	<b>4-Ethylquinoline</b> (γ-Ethylquinoline)	272-4			]		149	178-80	204	
101	N,N-Dimethyl-1-aminonaphthalene	273		1 62415	1 044615			145		1,3,5-Trinitrobenzene
	(N,N-Dimethyl-α-naphthyl-	ĺ								add comp, 105 7
	amine)		\ \						-24	
	5,8-Dimethylquinoline	273 5	4 5		1 0721			198	234	01-4- 107
103	3-Bromoquinoline (β-Bromo-	274 6	12					190		Oxalate, 107
104	quinoline) 3,5-Dimethyl-1-phenylpyrazole	275					190	103	186	
	6-Bromoquinoline	278	19, 24				278	217		
	2,4,7-Trimethylquinoline	280-1		1 597324	1 033720	l	322	232	272	
	4,7-Dimethylquinoline	283	] [					224	227	
	3,4-Dimethyl-1-phenylpyrazole	285		1 572420	1 057440			122 5	180	
	8-Chloroquinoline	288					165		235	
110	2,3'-Bipyridyl	289, 298						150, di 165-8		
111	8-Bromoguinoline	302-4					281	103-8	230	11:
	6-Methoxyquinoline	1	20, 28				236	305	250	
	N-Benzyl-N-methylaniline	306		1 601 <sup>30</sup>	1 042226		164	127		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## 2. Tertiary amines a) Liquids (b.p. at reduced pressure only)

2) (Listed in order of increasing m.p. of the corresponding picrate derivative)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Methyl p-toluene sulfonate	Methio dide	Picrate	Chloro- platinate	Miscellaneous
1	N,N-Dimethyl-2-ntroaniline	151 3 <sup>30-3</sup> , or -yel		1 6102			,	102 3		Hydrochloride, 174, 1,3,5- Trinitrobenzene add comp, 112
2	2,6-Diethylpyridine	71 317					142	115	211 2	,
3	1	9313	]	1 636620	1 9735%		207	120	210	
4	1,3-Dimethyl-1,2,3,4-tetrahydroquinoline	130 217	ĺ				204	131	Į	
5	1	110 214					:	131		Reduces Fehling's and Tollen's reagent Zn + AcOH → aniline, b p 184 + diethylamine b p 56
6	3-Dimethylaminobenzaldehyde	138 <sup>9</sup> , yel					185 6	147	168 r h	zone, 229 p-Nitrophenyl- hydrazone, 188
7	4-Methyl-5,6,7,8-tetrahydroquinoline	12211					183	170	1	Hydrochloride, 203
8	3-Methyl-5,6,7,8-tetrahydroquinoline	126 717					162	171	219	
9	3-Ethylquinoline (\(\beta\)-Ethylquinoline)	135 812		1 60318	1 050840		191	197		Hydrochloride, 173
10	<b>4-Bromopyridine</b> (γ-Bromopyridine)	27 5 30° 3-0 5	0-1	1 567920				223		Decomposes to yel -br solid on standing

<sup>\*</sup>Derivative data given in order in p , crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Methyl p-toluene sulfonate	Methio- dide	Picrate	Chloro platinate	Miscellaneous
1.	Pyrimidine	21	123 4			156		Chloroaurate, 226
2	4,6-Dimethylpyrimidine	25	160			12 34	103 4	
3	2,8-Dimethylquinoline	27	252		221	180		n <sub>D</sub> 1 6022, Ethiodide, 229
4	<b>4-Bromoquinoline</b> ( $\gamma$ -Bromoquinoline)	29 30, 25	270d		265 70			
5	Quinoxaline (Benzopyrazine)	30	230		176			D4* 1 1334, n6* 1 6231, Oxalate, 169, Ethiodide, 146
6	5-Methylpyrimidine	30 5	154			141		HgCl <sub>2</sub> double salt, 246, Chloro aurate, 209
7	• • • • • • • • • • • • • • • • • • • •	31	263		250	212	278	
8	7-Chloroquinoline	31-2	267-8		250		253	
9	8-Iodoquinoline	36 37	170		200	147	251 187 91	n58 1 4500
11	1,3,5-Trimethylpyrazole 2-Chloroquinoline (α-Chloroquinoline)	38	267			122	18/ 91	n5% 1 4589
	2,3-Dimethyl-5,6,7,8-tetrahydroquinoline	38	12514	ļ	117	169		
13		39	252		117	237	223-4	
14	4-Bromoisoquinoline	40	280 5		233	237	223-4	
15	6-Chloroquinoline	41	262	143	248			Ethiodide, 168-9
	4-(Diethylamino)benzaldehyde	41, yel	202	143	240			Oxime, 93, Semicarbazone, 214
	T Dietayiamino/benzaidenyde	141, jei						Phenylhydrazone, 103, Anil, 108-9
17	3-Nitropyridine	41	216			1	254	Hydrochloride, 154
18	2,4,8-Trimethylquinoline	42	270		229	193		
19	4-Chloro-2-methylquinoline	42 3			212	178		
	(4-Chloroquinaldine)				-			
20	5-Chloroquinoline	45	256	1	231, 172	ļ	255	
21	2,6,8-Trimethylquinoline	46	264 5			187-9	206-7	Hydrochloride, 207
22	2-(Dimethylamino)naphthalene (N,N-Dimethyl-\(\beta\)-naphthylamine)	47	305			206		
23	2,4,5,8-Tetramethylquinoline	48, pa yel	168-7212			161		Hydrochloride, 254
	5-Bromoquinoline	48, 52	280		205			Hydrochloride, 225
	<b>2-Bromoquinoline</b> ( $\alpha$ -Bromoquinoline)	49			210			
	8-Methoxyquinoline	50	283	Ì	160	143		
27	7-Bromoquinoline	52, 34	290		240, yel			Hydrochloride, 213
	<b>2-Iodoquinoline</b> (α-Iodoquinoline)	52-3			211-2			Ethiodide, 220
29	3-Iodopyridine (β-Iodopyridine)	53, 50					211	Clinice cold CHCl₃ → chloride 128 30, yel
30	4,8-Dimethylquinoline	54 5	258 9	Ì		216 7	226	
31	2,3,8-Trimethylquinoline	55-6	281			242 5		Hydrochloride, 260
1	2,6-Dimethylquinoline	60	266	175	236-7	186, 178		Styphnate, 200
33	N,N-Dimethyl-3-nitroaniline	60, red	***		205	119		
	3,4'-Bipyridyl	62	297			215		
	2,4,6-Trimethylquinoline	65 5 (anh ), 39 5 (hyd )	281 2		245-7, 225	200-1		Hydrochloride, 268-72
	3,3'-Bipyridyl (β,β-Bipyridyl)	68 68 9	291-2		218	232	230	
	<b>2,3-Dimethylquinoline 2,2'-Bipyridyl</b> ( $\alpha,\alpha'$ -Bipyridyl)	69	263		218	230 I 158	230	
	<b>5-Nitroquinoline</b>	72 (anh )			215	130		Hydrochloride, 214
	N,N-Dibenzylaniline	72 (21111)			135	131		11901001101106, 214
	2,2'-Bis-(dimethylamino)-biphenyl	72-3	1		190-2	131		Hydroiodide, 256-7
	3,4-Dimethylquinoline	73-4, 65	293	1	191	215, 205		Hydrochloride, 290
	8-Hydroxy-2-methylquinoline (8-Hydroxyquinaldine)	74	266		.,,	210,200		Me eth , 125, b p 282
44	(6-Hydroxyquinaidine) 4-Dimethylaminobenzaldehyde	74		,				Semicarbazone, 222, p-Nitro- phenylhydrazone, 182, 2,4-Di- nitrophenylhydrazone, 325,
45	8-Hydroxyquinoline	75			143	204		Anil, 100, grn -yel Benzoate, 120, 1,3,5-Trinitro-
46	N,N-Dimethyl-4-aminophenol (N,N-Dimethyl-4-hydroxyanılıne)	76						benzene add comp, 124 Acetate, 78, Me eth, 49, p- Toluenesulfonyl, 130
47	8-Bromoisoquinoline	80 5	ļ		274			Nitrate, 193
7'	o-Diomoisodamonne	1003	1		~'~	1	1	11111111, 173

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Methyl p-toluene sulfonate	Methio- dide	Picrate	Chloro- platinate	Miscellaneous
48	3,4'-Biquinolyl	83-4				244		Diethiodide, 198
49	2,2'-Dipyridylamine	84, 95 after resolidifi- cation	307-8			2278	160	
50	N,N-Dimethyl-4-nitrosoaniline (4-Nitroso-N,N-dimethylaniline)	85	İ			140	Í	Hydrochloride, 177
51	N,N-Dimethyl-3-aminophenol (N,N-Dimethyl-3-hydroxyaniline)	85						Benzoate, 95, Me urethane, 87
52	2,3,6-Trimethylquinoline	86-7	285	1	Ì	212	1	1
53	6,6'-Dimethyl-2,2'-bipyridyl	89-90				170 1		HgCl₂ add comp, 238
54	4,4'-Bis-(dimethylamino)-diphenylmethane	91	390		214 (di)	185 (mono), 178 (di)		1,3,5-Trinitrobenzene add comp, 114, vlt
55	6-Iodoquinoline	91			> 300		265	Hydrochloride, 210
56	Tribenzylamine	91			184	190		Ethiodide, 190, β-Resorcylic acid salt, 141
57	2,3,4-Trimethylquinoline	92	285	į	260	216	215	Hydrochloride, 274
58	4-Dimethylaminobenzophenone	92	5		188-90			Anil, 151, Phenylhydrazone,
59	N-Methyl-4-pyridone	92-4 hyg					176 (anh )	HgCl <sub>2</sub> double salt, 177-80
60	1,5-Dimethylbenzimidazole	95	300			255	ļ	Hydrochloride, 215
61	1-Phenylisoquinoline	956	300	1		165	242	Hydrochloride, 235
62	6-Bromo-2-methylquinoline (6-Bromoquinaldine)	96 7			237		į	Ethiodide, 218
63	4-Iodoquinoline (γ-Iodoquinoline)	97			251	1	185	
	4,4'-Bis-(dimethylamino)-benzhydrol	98, 102,			195 (di)	}	105	Me eth, 71 2, 1,3,5-Trinitro-
	5 lada	grn	}		245		262	benzene add comp, 76
65	5-lodoquinoline	100			245		263	1.2.5 Tourstook and d
66	4,4'-Bis-(dimethylamino)-triphenylmethane	102, bz ,		{	231 (220)	l	ĺ	1,3,5-Trinitrobenzene add
67	(Leuco-malachite green)	93, al 103			(d1) 205	239, 210	<u> </u>	comp, 89
67	2,2'-BiquinolyImethane	103			203	(d1)	1	
68	<b>2-Hydroxypyridin</b> e (α-Hydroxypyridine, α-Pyridone)	106-7	280-1					Benzoate, 42, HgCl <sub>2</sub> comp with Me eth, 200, HgCl <sub>2</sub> comp with Et eth, 141-2
69	Acridine	111		1	224	208	Ì	comp with Et eth, 141-2
	3,5-Dibromopyridine	112	222	219	274	200		
	1,2-Dimethylbenzimidazole	112 (anh ), 65(hyd )	290		254	238		
72	Antipyrine (2,3-Dimethyl-1-phenyl-5-pyrazolone)	113	319			188		Salicylate, 92
73	4,4'-Bipyridyl	114 (anh ), 73 (hyd )				257		Nitrate, 256
74	4-Dimethylaminoazobenzene	117, yel	1		174, al			Methochloride, 194
75	Triphenylamine	127	365					Hydrochloride, 214, Fuming HNO <sub>3</sub> in ac a → trinitro deriv, 280
76	3-Hydroxypyridine (β-Hydroxypyridine)	129						Oxalate, 177, Chloroplatinate of Et eth, 192
77	Methyleneaminoacetonitrile	129	210			127		Acid hydrolysis → glycine
	7-Nitroquinoline	132 3		[	231-2		ļ	Ethiodide, 220
79	6,8'-Biquinolyl	148			126 (mono)	268		
80	4-Hydroxypyridine (γ-Hydroxypyridine)	149 (anh )			(mono)			Acetate, 140 50, Benzoate, 81, Zn → pyridine, b p 116
81	6-Nitroquinoline	154, 149		1	245			Styphnate, 190, Hydrobromide,
82	Quinuclidine	158 (sealed tube)				275-6	238–40	Ethiodide, 270–1
83	2,7'-Biquinolyl	160			263	240		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	Boiling point, °C	Methyl p-toluene sulfonate	Methio- dide	Picrate	Chloro- platinate	Miscellaneous
84	2,2'-Biquinolyl ketone	164				179		Oxime, 201, Phenylhydrazone,
85	6-Hydroxypyrimidine	164-5				190		Acetyl, 180, 215-20 after re-
86	7,7'-Biquinolyl	171-2			310 (mono)	300		
87	4,4'-Bis-(dimethylamino) benzophenone (Michler's ketone)	174			105	156		Oxime, 233
00	5,5'-Biquinolyl	175			272	>300		Hydrochloride, 292
	2,3'-Biquinolyl	176	İ		286	/300	278	Trydrocinoride, 272
	6,6'-Biquinolyl	181			> 290 (di)		270	Diethiodide, 270
	6-Hydroxyquinoline	193	i		> 290 (at)	236		1,3,5-Trinitrobenzene add
92	2,2'-Biquinoly! $(\alpha,\alpha'$ -Biquinoly!)	196			Ì	210, 215		' '
	3-Hydroxyquinoline (\(\beta\)-Hydroxyquinoline)	198			Ì	240-5		1
	1,2-Di(2-pyrrolyl)ethanedione (2,2'-Bipyrroyl)	200, pa yel						o-Phenylenediamine di- pyrrylquinoxaline, 158, Monoxime, 147, Diphenyl- hydrazone, 146
95	4-Hydroxyquinoline (γ-Hydroxyquinoline)	201 (anh )						Hydrochloride, 187 (anh ), KMnO₁ → kynuric acid, 200 (anh )
96	6-Hydroxy-2-methylquinoline (6-Hydroxyquinaldine)	213						Et eth, 71, Picrate of Et eth, 192, Ethiodide of Et eth, 182
97	5-Hydroxyquinoline	224	1		224		230	Hydrochloride, 240
	4-Hydroxy-2-methylquinoline (4-Hydroxyquinaldine)	232 (anh )			201 (anh )	200	215	Me eth, 82
99	7-Hydroxyquinoline	235		1	251	244-5		Benzoate, 88-9
	5-Hydroxy-2-methylquinoline (5-Hydroxyquinaldine)	246, 232-4						Picrate of Me eth, 217, Picrate of Et eth, 213, 206
101	4,4'-Dipyridylamine	273-5		1	i	235, 174	>280	Hydrochloride, > 300
	Hexamethylene tetramine	280		205	190	179		Dil acid → formaldehyde, semicarbazone, 169

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### **EXPLANATIONS AND REFERENCES TO TABLE XIX**

Substituted phenylhydrazones \*

nes \*

CH=O

(CHOH)<sub>n</sub> + 
$$XC_6H_4NHNH_2 \rightarrow (CHOH)_n$$

R

Substituted phenylhydrazone

From the carbohydrate and one equivalent of phenylhydrazine in aqueous acetic acid

For directions and examples see Cheronis, p. 520, Wild, p. 77

From the carbohydrate, phenylhydrazine hydrochloride and sodium acetate in water

See Wild, p 77

From the carbohydrate with *p*-nitrophenylhydrazine hydrochloride and sodium acetate in methanol *See* Cheronis, p. 523

From the carbohydrate and p-nitrophenylhydrazine in alcohol

See Vogel, p 456

From the carbohydrate and benzylphenylhydrazine in aqueous alcohol

See Shriner, p 77

#### Phenylosazone \*

CH=O

CH=NNHC<sub>6</sub>H<sub>5</sub>

(CHOH)<sub>n</sub> + 
$$3C_6H_5NHNH_2$$
  $\rightarrow$  C=NNHC<sub>6</sub>H<sub>5</sub> +  $C_6H_5NH_2$  +  $NH_3$  +  $2H_2O$ 

R

(CHOH)<sub>n</sub> |

R

Physiographs

From the carbohydrate and excess of phenylhydrazine in glacial acetic acid

For directions and examples see Cheronis, pp 523, 524

From the carbohydrate, excess of phenylhydrazine hydrochloride and sodium acetate in aqueous acetic acid

See Cheronis, pp 524, 525 Linstead p 38 Shriner, p 132 Vogel, p 455

From the carbohydrate and excess of phenylhydrazine in methyl cellosolve-glacial acetic acid mixture

See W T Haskins, R M Hann and C S Hudson, J Amer Chem Soc, 68, 1766 (1946)

#### Methylphenylosazone

CH=O

CH=NN(CH<sub>3</sub>)C<sub>6</sub>H<sub>5</sub>

(CHOH)<sub>n</sub> + C<sub>6</sub>H<sub>5</sub>N(CH<sub>3</sub>)NH<sub>2</sub> 
$$\rightarrow$$

C=NN(CH<sub>3</sub>)C<sub>6</sub>H<sub>5</sub> + C<sub>6</sub>H<sub>5</sub>NHCH<sub>3</sub> + NH<sub>3</sub> + 2 H<sub>2</sub>O

(CHOH)<sub>n-1</sub>

R

Methylphenylosazone

From the carbohydrate and as-methylphenylhydrazine in aqueous alcohol For directions and examples see Vogel, p 456

#### p-Phenylazobenzoate (ażoate) \*

CHOH

O (CHOH)<sub>n</sub> + 
$$p$$
-(C<sub>6</sub>H<sub>5</sub>N=N)C<sub>6</sub>H<sub>4</sub>COCl  $\rightarrow$  O (CHOCOC<sub>6</sub>H<sub>4</sub>(N=NC<sub>6</sub>H<sub>5</sub>)- $p$ )<sub>n</sub>

CH

CH

CH

CH

CH<sub>2</sub>OH

Azoyl chloride

CHOCOC<sub>6</sub>H<sub>4</sub>(N=NC<sub>6</sub>H<sub>5</sub>)- $p$ 

Carbohydrate azoate

From the carbohydrate and azoyl chloride (p-phenylazobenzoyl chloride) in anhydrous pyridine

For directions and examples see Cheronis, p 526, G H Coleman, A G Farnham and A Miller, J Amer

Chem Soc, 64, 1501 (1942), G H Coleman and C M McClosky, J Amer Chem Soc, 65, 1588 (1943)

### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

### EXPLANATIONS AND REFERENCES TO TABLE XIX (Continued)

Acetate

CHOH

O (CHOH)<sub>n</sub> + (CH<sub>3</sub>CO)<sub>2</sub>O 
$$\rightarrow$$
 O (CHOCOCH<sub>3</sub>)<sub>n</sub>

CH

CH<sub>2</sub>OH

CH<sub>2</sub>OCOCH<sub>3</sub>

Carbohydrate acetate

From the carbohydrate, acetic anhydride and sodium acetate

For directions and examples see Linstead, p 39, Shriner, p 212, Vogel, p 451, Wild, p 78

Specific rotation

Specific rotation can be used as means for identification For directions and examples see Cheronis, p. 578, Wild, p. 78

General references

C A Browne and F W Zerban, Physical and Chemical Methods of Sugar Analysis, 3rd edition, John Wiley and Sons, New York, 1941, J Stanek, M Carny, J Kocourek and J Pacak, The Monosaccharides, Academic Press, New York, 1963, pp 865 955, G R Pigman in The Carbohydrates, (Ed W Pigman), Academic Press, New York, 1957, pp 602 640

<sup>\*</sup>Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

# TABLE XIX. ORGANIC DER IVATIVES OF CARBOHYDRATES a) Liquids (Listed in order of increasing m.p. of the corresponding phenylosazone derivatives)\*

No	Name	Melting point,	Spec	ıfic rota	tion	Rf-Values in n-butanol- acetic	Pheny	losazone	( <i>p</i> -P	zoate Thenyl- enzoate)	p-Nitro- phenyl-	p-Bromo- phenyl-	Miscellaneous
		·c	[α] <sub>D</sub>	т, •с	Conc, Solvent	acid-water (4 1 5)	МР	[α] <sup>T</sup> Solvent	МР	[α] <sup>25</sup> <sub>6438</sub> , chl	hydrazone	hydrazone	
1	DL-Methyl- tetrose						140-2						Phenylbenzylhydra- zone, 99 100
2	Apiose	: :	+3 8, +5 6	20 15	c = 3 4, water		156						p-Bromophenyl- osazone, 210 2
3	DL-Gulose		730		water		157 9		Ė				Phenylhydrazone, 143, p-Bromophenylosazone, 183
4	L-Erythrose		+11 5 → +15 2 → +30 5	24	c = 3, water		164						Benzylphenylhydra- zone, $105$ , $[\alpha]_0^{20}$ +32 8, c = 5, 95° al , Triacetyl, 134
5	D-Erythrose		14 5	20	c = 11, water		164, 166	0 5, pyr - al					Benzylphenylhydra- zone, 105 6 [\alpha] <sub>0</sub> <sup>20</sup> +32 8, c = 5, 95% al, p-Bromophenylosa- zone, 195 Phenyl- hydrazone, 116
6	DL-Erythrose						164, 166-8						Benzylphenylhydra- zone, 83
7	DL-Erythrulose						164						Methylphenylosazone, 158 9
8	L-Erythrulose		+12	20	water		164						p-Bromophenyl osazone, 195
9	L-Idose		+527	20	c = 62,		168, 160						OSazone, 177
10	D-Gulose		-20 4 → +61 6	20	water water		168, 160	+6, c = 04, me al					Phenylhydrazone, 143 $p$ -Bromophenyl osazone, 186 Benzylphenylhydrazone, 124, $\{\alpha\}_{\mathbf{D}}$ - 24, $\mathbf{c} = 0.5$ , me al
11	β-Methylglycer- aldehyde		•				171						Benzylphenylhydra-
12	L-Methyltetrose		-30 5 → -16 5	20	$c = 9 47.$ $96^{\circ}_{o}$ al		172-3						zone, 116 Benzylphenylhydra- zone, 96 7 Diethyl mercaptal, 109
13	D-Rhamnose (6-Desoxy-D- mannose)		-8 25	16 5	c = 10, water		185, 191	–95 2, pyr				:	p-Bromophenylosa- zone, 225, 222-3
14	3-Amino-3-desoxy-		-61 →	18	water		207						N-Benzoyl, 128 30
15	D-glucose DL-Xylulose (DL-Xylo- ketose)		_ <b>78</b>				210 5						Methylphenylosazone, 173

<sup>\*</sup>Derivative data given in order in p , crystal color, solvent from which crystallized

# TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting	Speci	fic rotati	ion	Rf-Values in n-butanol- acetic	Pheny	losazone	( <i>p</i> -P	oate henyl- nzoate)	p-Nitro-	p-Bromo-	Miscellaneous
		point, *C	[α] <sub>D</sub>	т, •с	Conc, Solvent	acetic acid-water (4 1 5)	МР	[α] <sup>T</sup> <sub>D</sub> Solvent	МР	[a]25 chl	hydrazone	phenyl- hydrazone	
1	1,3-Dihydroxy- acetone	65-71 (mono- mer), 80 (dimer)					132				156, 160		Phenylhydrazone, 115, Me phenylosazone, 127 130 Diacetate, 46 7 Dibenzoate, 120, Di-p-nitroben zoate, 198, Oxime, 84
2	β-Melibiose di- hydrate (6-[α- D-Galacto- sido]-D-glu- cose)	82-5	+111 7 → +129 5	20	c = 4, water		176-8	+43 2, pyr	280	+172	1		p-Bromophenyl- osazone, 181 2, Phenylhydrazone, 145 160 Oxime, 186, Octaacetate, 177 5, [\alpha] \begin{center}
3	D-Ribose	87,95	-21 5, -23 7	20	c = 4, water	0 31	164 160					170, $([\alpha]_{D}^{20}$ -57, al)	p-Bromophenyl- osazone, 180 5, $\beta$ -Me glucoside, 83 4, $[\alpha]_{20}^{20}$ -113 6
4	L-Ribose	87	+20 3 → +20 7	20	c = 4, water		166	1				164 5	Phenylhydrazone, 154 5
5	2-Desoxy-D- ribose	90	+2 88 → +2 13	23	water						ĺ		Benzylphenylhydra- zone, 127 9
6	Glycollic alde- hyde (Glyco- aldehyde)	95 7					179						p-Nitrophenylosazone, 311, Diphenyl- osazone, 207, Benzyl- phenylosazone, 198, Monoacetate, 157, 8,
7	D-Fructose	102 4	-132 2 → -92 4	20	c = 4, water	0 23	210		125	-440	176, ([\alpha] <sub>D</sub> +16, pyr -al)		Phenylhydrazone, 162 a-Nitrophenylhydra- zone, 156 7 $\alpha$ -Me phenylosazone, 161 2. Pentaacetate $\alpha$ - form, 70, $[\alpha]_D^{20}$ + 34 7, chl $\beta$ -form, $108-9$ , $[\alpha]_D^{20}$ – 120 5, chl
8	Lactic aldehyde (Lactaldehyde)	105					154, 145				128 9		Phenylhydrazone, 93
9	α-L-Rhamnose (6-Desoxy-L- mannose)	105, 93-4 (hyd)	-8 6 → +8 2	20	c = 4, water	0 37	222, 182	+94, pyr			186 191		p-Nitrophenylosa- zone, 208, 2-Naph- thylhydrazone, 170, $\{\alpha\}_D + 84$ , me al. Semicarbazone, 183, $\{\alpha\}_D^{30} + 75 \rightarrow +57$ , w
10	L-Altrose	105、 107-9	-323	20	water	1	165 178						Benzylphenylhydra- zone, 148
11	D-Altrose	105	+32 6	20	c = 76, water		178						Benzylphenylhydra- zone, 148-50
12	2-Amino-2- desoxy-D-glu- cose (Glucosa- mine)	105-10	+48, +44		water		210						Phenylurea, 210, N-Acetyl, 190, Oxime, 127, Semicarbazone, 165
13	α-D-Lyxose	106-7, 101	+55→ -140		c = 8, water		164				172	162, 156 7	Benzylphenylhydra- zone, 116, 128, $[\alpha]_D^{20} + 26.4$ , $c = 4.9$ , abs al

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

# TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting	Spec	afic rotati	on	Rf Values in n-butanol-		losazone	( <i>p</i> -P	oate henyl nzoate)	p Nitro	p-Bromo	Miscellaneous
		point, °C	[α] <sub>D</sub>	т.с	Conc Solvent	acetic acid-water (4 1 5)	МР	[α] <sub>D</sub> <sup>T</sup> Solvent		hydrazone			
14	Raffinose (2- [6-( $\alpha$ -D Galactosido)- $\alpha$ -D- glucoside] $\beta$ - D-fructose)	118 9, (anh ) 80 (hyd )	+123, +105 2	20	water  c = 4,  water	0 05			145	+146			Tritrityl, 130, α- Methylphenylhydra- zone, 190, Emulsin  → sucrose + galac- tose
15	β-L-Rhamnose	122 6	+91	20	water		222 185	+94 pyr			190 1, $([\alpha]_{D}^{20} + 21 4)$		α-Methylphenylhy- drazone, 124, p-Bro- mophenylosazone, 222
16	D-Tagatose	124	+10	22	c = 1, water		196 7 201						Diacetone deriv, 65 6, $[\alpha]_D^{20}$ +71 8, w
17	D-Threose	126 32	+29 → +19 6	22	water		164	İ					Benzylphenylhydra- zone, 194, bz., Ace- tone deriv, 84, Tri- acetate, 113, 4, $[\alpha]_{0}^{20}$ + 35, 5, chl
18	D-1-Amino- fructose	127 8					210						1 55 5, 611
19	β-D-Allose	128	+0 58 → +14 41	20	c = 5, water		178, 174					145, $([\alpha]_D^{20}$ -67,	
20	β-L-Allose	128 9	-19	20	water		165					al) 141 5, $([\alpha]_D^{20} + 64,$ al)	
21	D-Talose	128 30	+30 → +20 6	21	water		201 197					205	Phenylhydrazone, 178, Benzylphenylhydra- zone, 199
	DL-Xylose α-D-Mannose	129 31	+29 3 → +14 2	20	c = 4 water	0 20	210 5 210				194 5, ([α] <sup>20</sup> <sub>B</sub> +56, pyr -al (1 1))	208 10	Phenylhydrazone, 199 $200$ , $[\alpha]_{D}^{20} + 263 \rightarrow$ $+338$ , pyr, $\alpha$ - Methylphenylhydra- zone, 178, $[\alpha]_{D} + 86$ , c = 05, me al, Benzylphenylhydra-
24	β-D-Mannose	132	-17 0 → +14 2	20	c = 4, water		210				194 5	208 10	zone, 165 Phenylhydrazone, 199 200, α-Methylphenyl- hydrazone, 178, CaCl <sub>2</sub> add comp, 101 2
25		132	+140→ -140		water		208						Phenyihydrazone, 195, $[\alpha]_D$ +1 2, HCl
		132 3 134 5	+85 05 → +68 64	20	c = 11 water		217 9 200					207-8	Phenylhydrazone, 195 Phenylhydrazone, 197, Hexaacetate, 106, 50% al, 139, 40, eth
28	DL-Glyceralde- hyde (dimer)	139, 142					132						p-Bromophenylosa- zone, 168, Diben- zoate, 231, Di-p-ni- trobenzoate, 247, Semicarbazone, 160, 2,4-Dinitrophenyl- hydrazone, 166-7
29	D-Isorhamnose (6-Desoxy-D- glucose	139-40	+72 3 → 29 7	20	c = 10, water	]	185, 187 9						• • • • • •

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

## TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting	Specif	ic rotatio	on	Rf-Values in n-butanol- acetic	Phenyl	osazone	(p-Pt	oate lenyl- izoate)	p-Nitro phenyl	p Bromo- phenyl-	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc , Solvent	acid water (4 1 5)	МР	[α] <sub>D</sub> <sup>T</sup> Solvent	МР	[a]25 chl	hydrazone	hydrazone	
30	α-L-Glucose	141 3	-95 5 → -51 4	20	c = 4, water		208						Diphenylhydrazone,
31	L-Xylose	144, 141 3	-79 3 + -18 6	20	c = 9 94, water		159 61						Tetraacetate, 126 (β-form)
	α-D-Xylose	145, 143	+93 6 → +18 8	20	c = 4, water	0 28	164 155	-40 9. al	157	+ 244	155	128	Me phenylhydrazone, 108. Benzylphenyl- hydrazone, 95, [α] <sub>D</sub> -33, c = 0 57, al 2-Naphthylhydra- zone, 124, [α] <sub>D</sub> +18 6, me al Methylphenylosazone,
33	D-Fucose (6- Desoxy-D- galactose, D-Rhodeose)	143	+75 7 +75 7		water		1//						181, Oxime, 188 9, $\{\alpha\}_{D} + 13 2, w$
34	L-Fucose (6-Desoxy-L-galactose, L-Rhodeose)	145	-152 6 → -75 9	20	c = 4 water	0 27	178				210 1	181 4	Phenylhydrazone, 170, $\alpha$ -Methylphenylhydrazone, 174, $\{\alpha\}_b^b$ – 17 0, pyr Oxime, 188 9, $\alpha$ -Me glucoside, 158, $\{\alpha\}_b^m$ – 197 5, w $\beta$ -Me glucoside, 119, $\{\alpha\}_b^m$
35	α-D-Glucose	146 (anh ), 83 (hyd )	+112 2 → +52 7	20	c = 4, water	0 18	210	-15, c = 2, pyr-al (11)	266	+223	88, 196 ([\alpha] <sub>D</sub> +21 5, me al )	$ \begin{array}{c} 164 & 6, \\ ([\alpha]_{D} \\ -43 & 6 \rightarrow \\ +18 & 9 \\ c & = 4, \\ pyr & ) \end{array} $	+16 04, w 2-Naphthylhydrazone, 178 p-Nitrophenyl- osazone, 257, 2,4- Dinitrophenylosa- zone, 256 7, α-Penta- acetate, 112
36	2-Desoxy- D-glucose	148	+46 6	18	water							·	Benzylphenylhydra- zone, 158-9
37	β-D-Glucose	148 50	+18 7 → +52 7	20	c = 4, water		210						p-Nitrophenylosa- zone, 257 2,4-Di- nitrophenylosazone, 256 7 β-Penta- acetate, 132
38	Melezitose (2-[3-(α-D-Glucosido)-D-fructosido]-α-D-glucose)	153-4 (+2 H <sub>2</sub> O)	+88 2	20	c = 4, water				(sin- teres)	+188			
39	Turanose (3-[α- D-Glucosido]- D-fructose)	157 (anh ), 60 5 (hyd )	+27 3 → +75 8	20	c = 4, water		215 20				i		Heptaacetate, 140 1, eth, $[\alpha]_{B}^{2n} + 37$ , chl
40	$\beta$ -D-Arabinose	158-9	-175 → -105		c = 9 45, water	0 21	162 3, 160						Oxime, 136, Benzyl- phenylhydrazone, 173
41	β-L-Arabinose	160	+190 6 → +104 5	20	water		166		262	+755	186	155	Benzylphenylhydrazone, 174, Me phenylhydrazone, 165, Oxime, 139, Tetraacetate, α-form 94 6, eth. β-form 86, w. Tetrabenzoate, 160 1, 173, Semicarbazone, 190, 163

<sup>\*</sup>Derivative data given in order m p., crystal color, solvent from which crystallized

# TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting	Specif	fic rotation	on	Rf Values in n-butanol-	Phenyl	osazone	( <i>p</i> -P	oate henyl- nzoate)	p-Nitro- phenyl-	p-Bromo- phenyl-	Miscellaneous
		point, °C	[α] <sub>D</sub>	т, •с	Conc , Solvent	acetic acid-water (4 1 5)	МР	[α] <sub>D</sub> <sup>T</sup> Solvent	МР	[a]25 chl	hydrazone	hydrazone	
42	β-D-Galac- turonic acid	160	(+55 3)	20	water			-				151 ([α] <sub>D</sub> +11 5, me al )	Phenylhydrazone, 140, Brucine salt, 180
43	β-Maltose (4-[ $α$ -D- Glucosido]- $β$ - D glucose)	160 5, 102 3 (+1 H <sub>2</sub> O)	+111 7 → +130 4	20	c = 4, water	011	205-6		275	+2		ine ary	Phenylhydrazone, 130, $p$ -Nitrophenylosazone, 261, $p$ -Bromophenylosazone, 198, 2-Naphthylhydrazone, 176, Octaacetate, 160 1, $[\alpha]_{b}^{20}$ +62 59, chl
44	DL-Fucose (6-Desoxy- DL-galactose, DL-Rhodeose)	161				:	187						Diacetone deriv, 41
45 46	DL-Sorbose L-Galactose	162 3 162-3	-120 → -73 6 →		c = 10, water	0 20	169 70 192 5					•	Phenylhydrazone, 158 $60, [\alpha]_D + 216$ , w
47	DL-Galactose	163, 144					206					•	Phenylhydrazone, 158 60, α-Methyl- phenylhydrazone, 183
48	β-D-Glucuronic acid	163	+363	20	water						225		Semicarbazone, 188, Cinchonine salt, 204, $[\alpha]_0^{20} + 139.9$ , w
49	DL-Arabinose	164					169					160	Diphenylhydrazone, 204, p-Bromophenyl- osazone, 200-2
50	L-Sorbose	165, 159 61	-43 7 → -43 4	20	c = 12, water	0 20	156, 168	-6, me al					p-Bromophenylosazone, 181 o-Nitrophenylosazone, 211 2, $\beta$ -Me glucoside, 120-2, $[\alpha]_D^{\alpha}$ - 88 5, w, Pentaacetate, 97, $[\alpha]_D$ + 29, chl
51	D-Sorbose	165	+42 9	20	c = 1, water		168, 1 <b>6</b> 0						β-Me glucoside, 119, [ $α$ ] <sub>D</sub> +88 5, w
52	3-(β-D-Galac- tosido)-D- arabinose	166-8	-50 3 → +63 1	19	water		242						Benzylphenylhydra- zone, 223-5
53	α-D-Galactose	167	+150 7 → +80 2	20	c = 5, water	0 16	196, 201		276	+436	154, 197	168	α-Methylphenylhydra- zone, 190-1, Benzyl- phenylhydrazone, 157, Diphenylhydra- zone, 157, α-Penta- acetate, 95
54	Stachyose (α-Galactosyl 1-6/α-galactosyl 1-4/α-glucosyl 1-2/β-fructoside)	167-70	+148	20	water								Tetradecaacetate, 95-6, [\alpha]\beta^2 + 120, al, Tetradeca-p-nitro- benzoate, 166
55	Sucrose (2-[ $\alpha$ -D-Glucosido]- $\beta$ -D-fructose)	169 70, me al, 185, w - al	+66 53	20	c = 26, water	0 14			125	+35			Nonreducing, Octa- acetate, 72, 69, $[\alpha]_b^{\mu\nu}$ +59 6, chl , Tritrityl, 128

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting	Speci	fic rotati	on	Rf Values in n-butanol- acetic	Pheny	losazone	( <i>p</i> -F	oate henyl- nzoate)	p-Nitro-	p-Bromo- phenyl-	Miscellaneous
		point, C	[α] <sub>D</sub>	т, °с	Conc, Solvent	acid-water (4 1 5)	МР	[\alpha]_D^T Solvent	МР	[\alpha]^{25}_{6438}, chi	hydrazone	hydrazone	
56	D-Glucoheptu- lose	171	+674	20	water		209-10						Hexaacetate, 112, $[\alpha]_{D}^{20}$ +87 0, $\alpha$ -Me gluco- side, 138 40, $[\alpha]_{D}^{22}$ +108 5 w
57	4- β-D-Gluco- sido -β-D- mannose	176 (anh ), 139 40 (hyd )	+15 1 → +10 7	16	water		198						
58	α-L-Rhamno- hexose	180 1	-80 → -61 4	20	c = 9 67, water		200						Benzylphenylhydra- zone, 183 4
59	L-Ascorbic acid	190, 187	+49	18	me al	0 38					262 (d1)	170 (dı)	Diphenylhydrazone, 187 Di-2,4 dinitro- phenylhydrazone, 282
60	Gentiobiose (6-[β-D-Glu- cosido] D-glu- cose)	190-5 (anh), 86 (hyd)	+21 4 → +8 7	20	c = 5, water		163 4, 170, 179	-42 9 <sup>20</sup> , 95° <sub>o</sub> al					Octaacetate ( $\alpha$ ) 188 9, [ $\alpha$ ] <sup>20</sup> +52 3, chl, ( $\beta$ ) 192 3, [ $\alpha$ ] <sup>20</sup> -5 3, chl
61	α-D-Glucohep- tose	193	- 20	20	water		194–5						β-Me glucoheptoside, 169, $[\alpha]_D$ – 75, w. Hexaacetate, 164 (α form), 135 (β-form)
62	α,α-Trehalose (1-[α-D-Glu- cosido]-α-D- glucose)	210 203 (anh) 97 (+2 H <sub>2</sub> O)	+178 3	20	c = 7, water				134 5	+210			Nonreducing Octani- trate, 124 Octaace- tate, 100 2, $[\alpha]_B^{20}$ +162, chl Hexaace- tate, 93-6, $[\alpha]_B^{10}$ +158 3, chl
63	Primeverose (6-[β-D-Xylo- sido]-D-glu- cose)	210, 208	+24 1 → -3 3	i	c = 25, water		220						β-Heptaacetate, 216, $[\alpha]_D^{20} = 23.5$ , chl
64		α-form, 223 (anh), 201 (hyd), β-form, 252 (anh)	+90 → +55 3 (+52 3) +35 → +55 3 (+52 3)	20	c = 4, water c = 4, water	0 09	200, 210-2						p-Nitrophenylosa- zone, 258, Octaace- tate, 100 Benzyl- phenylhydrazone, 128, 2-Naphthylhy- drazone, 203
65	β-Cellobiose (4-{α-D-Glu- cosido]-β-D- glucose)	225	+14 2 → +34 6	20	c = 8, water		208 10, 198	-6 5 <sup>20</sup> , pyr -al (1 1)	273	+105			Phenylhydrazone, 90, Octaacetate, ( $\alpha$ ) 229 30, [ $\alpha$ ] $^{\circ}$ +42, ch1, Semicarbazone, 183 5, Octaacetate ( $\beta$ ), 192, 202, [ $\alpha$ ] $^{\circ}$ -14 5, ch1, Oxime,
66	6-[ $eta$ -Cellobio- sido]- $lpha$ -D-glu- cose	247-52 (anh ), 200 (hyd )	+150→ +84		water		224						123 5
67	6-[-β-Lacto- sido]-α-D- glucose	257	+34 7 → +22 6	24	water		233					!	

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE XX**

Formation of amine by reduction \*

$$RNO_2 + 6[H] \rightarrow RNH_2 + 2H_2O$$
Amine

From the nitro compound and tin in hydrochloric acid

For directions and examples see Cheronis, p 625, Linstead, p 69, Shriner, p 262, Vogel, p 529, Wild, p 247

From catalytic hydrogenation (Raney nickel, platinum oxide and palladium on charcoal) of the nitro compound in ethanol, methanol or dioxane

See Cheronis, p 626, Linstead, p 70, N D Cheronis and M Koeck, J Chem Ed, 20, 488 (1943), K Johnson and E F Degering, J Amer Chem Soc, 61, 3194 (1939), S V Voris and P E Spoerri, J Amer Chem Soc, 60, 935 (1938), E R Blout and D C Silverman, J Amer Chem Soc, 66, 1442 (1944)

From the nitro compound and lithium aluminum hydride in ethers

See N G Gaylord, Reduction with Complex Metal Hydrides, Interscience, New York, 1956, pp 762-773

For partial reduction of polynitro compounds with sodium or ammonium polysulfide see Linstead, p 71, Vogel, p 551

NOTE For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitro compounds see explanations and references to Table XVIII, p. 291, 292, 293, 294

Polynitro derivative \*

$$ArNO_2 \xrightarrow{HNO_3} Ar(NO_2)_n \quad n > 1$$

From the aromatic nitro compound with concentrated or fuming nitric acid and sulfuric acid For directions and examples see Cheronis, pp 580, 627, Shriner, p 249, Vogel, pp 526, 527 From fuming nitric acid in acetic acid or acetic anhydride

See Wild, pp 24, 247, 248, J Reilly and W J Hickinbottom, J Chem Soc, 117, 135 (1920), O L Brady and W H Gibson, J Chem Soc, 119, 102 (1921)

Molecular compounds of aromatic polynitro compounds with aromatic hydrocarbons

$$Ar(NO_2)_n + Ar'H \rightarrow Ar(NO_2)_n \cdot Ar'H \quad n > 1$$

Molecular compound

Molecular addition compounds are formed from the aromatic polynitro compound and aromatic hydrocarbons

For directions and examples see Table IV, p 32, 33, 34 Wild, p 248, T Asahina and C Shinomiya, J Chem Soc Japan, 59, 341 (1938), O C Dermer and R B Smith, J Amer Chem Soc, 61, 748 (1939)

Nitroaromatic acids from side-chain oxidation

From the alkylaromatic nitro compound and basic aqueous potassium permanganate For directions and examples see Cheronis, p. 627, Vogel, p. 629
From the alkylaromatic nitro compound and sodium bichromate and sulfuric acid in water See Cheronis, p. 628, Vogel, p. 629

<sup>\*</sup>Derivatives recommended for first trial

# TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS a) Liquids (Listed in order of increasing atmospheric b.p.)\*

						Da			nding amii all nitro gi	ne obtained	d on		ration	
No	Name	Boiling point,	Melting		Density	An	nine		T			<u> </u>	Γ	Miscellaneous
140	Name	°C	*C	n <sub>D</sub>	g/ml	Boiling point, °C	Melting point, °C	Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point, °C	Position of nitro groups	Miscellalieous
1	Nitroethylene	98 9			1 07314	16 5			71	58	165			Polymerizes readily on contact with base
2	Nitromethane	101	- 17	1 379725	1 12974	6		28	80	30	207 215			,
3 4	Nitroethane 2-Nitropropane	114 120		1 392 <sup>20</sup> 1 394	1 0497 <sup>20</sup> 1 024 <sup>0</sup>	16 5			71 26	58	165			Phenylthiourea deriv of amine, 101, 1-Naphthyl- urea deriv of amine, 200
5	3-Nitropropylene (3 Nitropropene)	125 30			1 05121	58				39	140			,
6	1-Nitropropane	132			1 00821	49			84	36	135			
7 8	DL-2-Nitrobutane 2-Methyl-1-nitro- propane	140 140 1		1 4013	0 9877"	63 69			76  57	70 53	139-40   150			p Toluenesulfona- mide deriv of amine, 78
9	2-Methyl-2-nitro- butane	150			]	78					183			amme, 76
10		152 4				92	[ ]							Hydrochloride of amine, 168, Oxa-
11	1-Nitrobutane	153		1 410320	0 9710 <sup>20</sup>	77					151			late, 226 131 Chloroaurate, 82 3 Phenylthiourea de- riv of amine, 65, 1-Naphthylurea deriv of amine, 149
12	1-Nitroisobutylene	154-8			1 0528	69			57	53	150			14)
13	(1-Nitroisobutene) 3-Methyl-1-nitro- butane	164				96					138			Phenylthiourea de- riv of amine, 102, 1-Naphthylurea
14	1-Nitropentane	173		1 4175	0 952520						139			deriv of amine, 132 Phenylthiourea de- riv of amine, 69, 2-Naphthylthio- urea deriv of am- ine, 114
	2-Nitrohexane 1-Nitrohexane	176 193		1 4234	0 93578° 0 93962°				40	96	126			
17	1-Nitroheptane	193 5		1 4234	0 947617				40		121			Phenylthiourea de- riv of amine, 75
18	2-Nitroheptane	194 8			0 9466º	142								Hydrochloride of amine, 133 Oxalate, 204 5, Chlo-
19	Nitrocyclohexane	205 6	-34	1 461219	1 06819	134		104	147		i		ı	roaurate, 63-4 SnCl <sub>2</sub> + HCl → Cyclohexanone
20	1-Nitrooctane	206 10 part d			0 934620	180					112			oxime 89 90 I Naphthylthio- urea deriv of am- ine, 72
	Nitrobenzene 2-Nitrotoluene	210 1 222		1 553 <sup>20</sup> 1 5474 <sup>20</sup>	1 2031 <sup>20</sup> 1 1622[ <del>§</del>			114 110 11	160 146, 143	112 124	213	90 70 I	1,3 2,4	mo, 72

<sup>\*</sup>Derivative data given in order im pi, crystal color, solvent from which crystallized

## TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

						Da		correspond		e obtained oups	on		ation duct	
No	Name	Boiling point,	Melting point,	n <sub>D</sub>	Density	Am	ine			Benzene		Melting	Position	Miscellaneous
		·c	· ·c	J	g /ml	Boiling point, °C	Melting point, °C	Acet- amide	Benz- amide	sulfon- amide	Picrate	point, *C	of natro groups	
23	1-Ethyl-2-nitroben-	224		1 540719	1 12624	210 11:		111-2	147		194 5			
24	1,3-Dimethyl-2- nitrobenzene (2- Nitro-m-xylene)	226	13		1 11215	215 218		177	168		180	182	1,3,5	p-Toluenesulfon- amide deriv of amine, 212
25	Phenylnitromethane	226d		1 532320	1 159820	184-5	1	60	105	88	194			
26	3-Nitrotoluene	233	16	1 547021	1 157120	203	]	65	125	95	200			Oxid → 3-nitroben- zoic acid, 140
27	1,4-Dimethyl-2- nitrobenzene (2- Nitro-p-xylene)	241 2			1 13215	213-5		139	140	138	171	139	1,2,4	
28		241		1 545819	1 12425	216 214		94	151			37	2,4,6	p-Toluenesulfon amide deriv of amine, 104
29	1,3-Dimethyl-4- nitrobenzene (4- Nitro-m-xylene)	246	2		1 12617 5	217		133	192	129-30	209	182	1,3,5	,
30		250	15			221-2		135	189		221	82	1,2	
31	2-Nitro-p-cymene	264	1	1 530920	1 074420	241	l	71	102		İ	54	2,6	
32	2-Nitroanisole	265	10	1 562020		225	5-6	85 88	60 84	89	200	68	2,4,6	
33	(	267				230	17	169-70						Dil HNO <sub>3</sub> → 4- nitrobenzoic acid, 240
34	2-Nitrophenetole	268	5-6	1 542520	1 190315	229		79	104	102		86	2,4	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

# TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS b) Solids (Listed in order of increasing m.p.)\*

				'			ding amine		חמ		ation duct	
No	Name	Melting point,	Boiling point,	Aı	mine					Melting	Position	Miscellaneous
		· ·c	·c	Boiling point, °C	Melting point, °C	Acet- amide	Benz- amide	Benzene sulfon- amide	Picrate	point C	of nitro groups	
1	2-Methyl-2-nitropropane (tert-Nitrobutane)	25 6	127	46			134		198			Phenylthiourea deriv of amine,
2	l '	25-7		184 6		152	185					N-p-Nitrobenzamide deriv of amine, 181
3	1-Nitro-2,3,6-trimethyl- benzene	30		235		186						
4	3,4-Dimethyl-1-nitro- benzene (4-Nitro-o- xylene)	30		226	51, 47 8	99				82	1,2	N-Formyl deriv of amine, 52 N-Chloroacetyl, 109
5	2-Chloro-1-nitrobenzene 2,4-Dichloro-1-nitro- benzene	32 33	258	209	63	87 143-6	99 115	129 128	134 106	50 52	2,4	N-Formyl deriv of amine, 154
7	4-Bromo-3-nitrotoluene	33		13616		121, 114						
8	3-Nitrophenetole (3- Ethoxy-1-nitro- benzene)	34		248		97	103		158			p-Toluenesulfonamide deriv of amine, 157
9 10	2-Nitrobiphenyl 6-Chloro-2-nitrotoluene	37, 33 37	238		49-50 245	121 157-9 136	102 173					N-Formyl deriv of amine, 75 Oxid → 6-chloro-2-nitro- benzoic acid. 161
11	3-Iodo-1-nitrobenzene	38, 35			33, 27	119	157					p-Toluenesulfonamide deriv
12	3-Nitroanisole (3- Methoxy-1-nitro benzene)	38	258	251		81			169	106	3,5	p-Toluenesulfonamide deriv of amine, 68
13	4-Chloro-2-nitrotoluene	38	240		21-2	139 40, 131						Oxid → 4-chloro-2-nitro- benzoic acid, 142
14		40, yel	15214	250	37-8	106	137		_			
15	2-Bromo-1-nitrobenzene	43	13910	250	32 - 3	99 126	116 136		129	72	1,3	
16 17	4-Nitroindane Nitromesitylene	44 44	139**	236 232 3	-3	216-7	204		189 91	86	dı	p-Toluenesulfonamide deriv
18	3-Chloro-1-nitro- benzene	45		230		72, 78	119 20	121	177			
19		49, yel	İ		98	156	ļ		,			
20	1	49			61, 58	109	139		112	70		
21 22	4-Nitrotoluene 4-Chloro-1,3-dinitro- benzene (1-Chloro-2,4-	52 52	234	200	45 91	147 142 (dı)	158 178 (d1)	120	182	70 183	2,4 2,4,6	NaOH → 2,4-Dinitrophenol, 114, Hydrazine → 2,4-di-
23	dinitrobenzene) 4-Nitroanisole (4- Methoxy-1-nitro-	53		240	58	130, 127	154	95		89	2,4	nitrophenylhydrazine, 199
24	· '	54			50, lgr	132	120			104	1,3	
25	benzene 4-lodo-3-nitrotoluene	55			48, 38	151, 136						N-Formyl deriv of amine, 129, NaOH → 3-Nitro-p- cresol, 36-7
26	3-Bromo-1-nitrobenzene	56		251	18	87	120, 136		180	59	1,2	
27	1-Nitronaphthalene	57, 60			50	159	160	167	163, 181			
28	β-Nitrostyrene	58, yel	250- 60d									Irradiation+ dimer, 180-7
29	1-Methyl-2-nitro- naphthalene	58-9, yel			51	188-9	222					

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p , crystal color, solvent from which crystallized.

# TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

-	-			Г		correspond uction of al			on .	Nitra		
No	Name	Melting point,	Boiling point,	Ar	nine							Miscellaneous
		°C	°C	Boiling point, °C	Melting point, °C	Acet- amide	Benz amide	Benzene sulfon- amide	Picrate	Melting point, °C	Position of nitro groups	
30	4-Nitrophenetole (1- Ethoxy-4-nitro- benzene)	60 58		248 254	3 4	137	173	143	69	86	2,4	
31	3,4-Dinitrotoluene	61		265	89 90	4 mono 131 2, di 210	3-mono 193 4 di 263 4	178 9 (di)				Oxid → 3,4-dinitrobenzoic acid, 165, 161
32	3-Nitrobiphenyl	61,59	l		30	148		ł				
33	2,3-Dinitrotoluene	63		255	63 4							$(NH_4)_2$ S $\rightarrow$ 2-Nitro-m-tolut- dine, 108, red HNO <sub>3</sub> $\rightarrow$ 2,3- Dinitrobenzoic acid, 201
34	1-Methyl-8-nitro-	63 4	ĺ		67 8	183-4	195 6					
35	naphthalene 2,6-Dinitrotoluene	66			105	202 3				80, 82	2,4,6	Oxid → 2,6 Dinitrobenzoic acid, 202 3
36	<b>2,4,6-Trinitroanisole</b> (1-Methoxy-2,4,6-trinitrobenzene)	68										Naphthalene adduct, 69-70, NH₃ in al → picramide, 188
37	<b>2,4</b> -Dinitrotoluene	70, 72		292	99	224 (dı)	224 (di )	2 mono 138 di 191		80 82	2,4,6	Naphthalene adduct, 60, Oxid → 2,4-dinitrobenzoic acid 182-3 SnCl <sub>2</sub> + HCl → 4-Nitro-o-toluidine, 107 vel
38	2-Nitroazobenzene	71, or - red			59	126	122	171				
39	1-Methyl-4-nitro- naphthalene	71-2, pa yel			51 2	166 7	238 9					Dil HNO <sub>3</sub> → 4-nitro-1- naphthoic acid, 220-1
40	4-Bromo-1,3-dinitro- benzene (1-Bromo-2,4- dinitrobenzene)	75, 72										NaOH → 2,4-Dinitrophenol, 114 Al NH <sub>3</sub> → 2,4-dinitro- aniline, 180 188, yel Sn + HCl → 1,3-Diaminobenzene 63, Hydrazine → 2,4-dinitro- phenylhydrazine, 199
41	3,5-Dimethyl-1-nitro-	75	273	220-1	l	144,						N-Formyl deriv of amine,
42	benzene 4,5-Dimethyl-1,3- dinitrobenzene	76				140						76 7 (NH <sub>4</sub> ) <sub>2</sub> S → 1-Amino-3,4- dimethyl-5-nitrobenzene, 75 Acetyl deriv of this, 209-10, Benzoyl deriv of this, 223-4
43	5-Methyl-2-nitro- naphthalene	76 7			63 4	123-4	155-6					Benzoyi don orums, 225
	2-Nitronaphthalene	78	1		112	132	162	102	195			
45	2,4,6-Trinitrophenetole (1-Ethoxy-2,4,6-tri- nitrobenzene)	78										Naphthalene adduct, 39, NH₃ in al → picramide, 188
46		80, 82										Naphthalene adduct, 97; CrO <sub>3</sub> /conc H <sub>2</sub> SO <sub>4</sub> → 2,4,6- trinitrobenzoic acid, 220
47	2-Methyl-1-nitro- naphthalene	81, yel			32, pet eth	188	180					
48	4-Nitrophenanthrene	81			105	190	224					
49	3,4-Dimethyl-1,2- dinitrobenzene	82										Reduct → 1-amino-3,4- dimethyl-2-nitrobenzene, 66, red , Acetyl deriv of this, 115 6, Benzoyl deriv of this, 199-200

<sup>\*</sup>Derivative data given in order m p, crvstal color, solvent from which crystallized

# TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS b) Solids (Listed in order of increasing m.p.)\* (Continued)

				Ε			ding amine o		n	Nitra prod		
No	Name	Melting point,	Boiling point,	Ar	nine					Melting	Position	Miscellaneous
		·°C	°C	Boiling point, °C	oint, point, amide	Benz- amide	Benzene sulfon- amide	Picrate	point °C	of nitro groups		
50	5-Methyl-1-nitro-	82 3			77 8	194 5	173 4					
51	naphthalene Picryl chloride	83				208 (tri)		211		:		NaOH → Picric acid, 122 NH, → 2,4,6-Trinitroaniline, 188 192 5
52	4-Chloro-1-nitrobenzene	84		 	72	179 172	192	122				NaOH → 4 Nitrophenol, 114
53,	2,5-Dibromo-1,4-dinitro- benzene	127								-		2,5-Dibromo-p-nitroaniline, 175, yel
54	2,4-Dimethyl-1,3- dinitrobenzene	84 82			65 6, lgr	>260 (di)	232 (227) (di)					Reduct → 1 amino-2,4- dimethyl 3-nitrobenzene 84 NN Diformyl, 219 20
55	2,4-Dinitromesitylene	85								232	2,4,6	Reduct → 2-amino-4 nitro mesitylene, 75 Acetyl deriv of this 191 Benzoyl deriv of this, 169 Benzenesulfonyl deriv of this, 163
56	2,5-Dibromo-I-nitro- benzene	85			51 2	171 2						
57	4-Bromo-1-nitro- naphthalene	85			102	193						N-Formyl deriv of amine, 172
58	2,4-Dinitrophenetole 1 3-Dinitro-4- ethoxybenzene	86			67 8	193 (di)				78	2,4,6	Reduct → 2-nitro p-pheneti- dine, 40
59	4-Chloro-1-nitro- naphthalene	87 85			98	186						
60	1,3-Dinitrobenzene	90			63	87 9	240 (dt), 125 (mono)	194	184			$(NH_4)_2S \rightarrow 3$ Nitroaniline, 114 Naphthalene adduct, 52
61	2,3-Dimethyl-1,4- dinitrobenzene	90			116	(mono) 275 6 (di)	(mono)			:		1-amino-2,3-dimethyl-4- nitrobenzene, 114
62	3,5-Dinitrotoluene	92		283 5		235 6 (di)						Oxid $\rightarrow$ 3,5-dinitro-benzoic acid 204 5 (NH <sub>4</sub> ) <sub>2</sub> S $\rightarrow$ 5-Nitro- <i>m</i> toluidine 98
63	3,6-Dimethyl-1,2- dinitrobenzene	93			75							Oxid → 2,3-dimitro-p-toluic acid, 249
64	4,6-Dimethyl-1,3- dinitrobenzene	93			105	1-mono 165 di 295	258 9 (di)			125	4,5,6	N,N'-Diformyl deriv of amine, 182-3
65	2,4'-Dinitrobiphenyl	93		363	45	202 (di)	276 8 (di)					
66	8-Chloro-1-nitro- naphthalcne	94			88 9 96	137						
67	2,4-Dinitroanisole 1,3-Dinitro-4 methoxybenzene	95							i			2,4 Dinitrophenol, 114, Naphthalene adduct, 50, Reduct  → 2 amino-4-nitroanisole, 118, or -red, Acetyl deriv of this, 175 6
68 69	3-Nitroazobenzene 4-Chloro-2-nitroanisole (5-Chloro-2-methoxy-	96, or 98			56 7 84	130-1 104	77 8		194			
70	1-nitrobenzene) 2-Nitrophenanthrene	99, pa yel			85, pa	225	216					CrO <sub>3</sub> → 2-Nitrophenanthra- quinone, 260, golden yel
71	8-Bromo-1-nitro- naphthalene	99~100			yel 90	138 9						quinone, 200, goiden yei

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

				1			ding amine of		on		ation duct	
No	Name	Melting point,	Boiling point,	Aı	nine					1		Miscellaneous
	1.1	°C	·°C	Boiling point, °C	Melting point, °C	Acet- amide	Benz- amide	Benzene sulfon- amide	Picrate	Melting point, °C	Position of nitro groups	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
72	3,5-Dimethyl-1,4-dinitro- benzene	101			104							Reduct → 1-amino-2,6- dimethyl-4-nitrobenzene, 158
73	1,2-Dinitronaphthalene	102-3, br			98	234 (dı)	291 (dı)	1- mono 215				
74	5-Nitroacenaphthene	106, 101, yel			108	238	210, 199		190 200			
	2,β-Dinitrostyrene	106-7, yel					<u> </u>			:		Alk KMnO <sub>4</sub> → 2-nitro- benzoic acid, 146-8
	5-Chloro-1-nitro- naphthalene	111		261 2	85 75	128						
,,	3-Nitrodurene (3-Nitro- 1,2,4,5-tetramethyl- benzene)	112 3		201 2	13	207						
78 79	4-Nitrobiphenyl 9-Nitrophenanthrene	114 116-7		302	53 137 8, 104	171 207-8	230 199		190			N-Formyl deriv of amine, 172 Picrate, 78-9
80	1,2-Dinitrobenzene	118			102	185 (di)	301 (dı)	185				(NH <sub>4</sub> )S → 2-Nitroaniline, 71, Hot aq NaOH → 2-nitro- phenol, 45
81	2,4'-Dinitrodiphenyl- methane	118, yel			88-9	224 5 (210) (di)						Oxid → 2,4'-dinitrobenzo- phenone, 197
82	4,5-Dimethyl-1,2-dinitro- benzene	118, 115			126	227-8 (d1)						Reduct → 1-amino-4,5- dimethyl-2-nitrobenzene, 140
84	3-Methyl-2-nitro-1,4-	121-2, 125, yel										Dil KMnO <sub>4</sub> → phthalic acid, 200-6, Na <sub>2</sub> SO <sub>3</sub> Reduct or Fe + ac a → 2-amino-3- methyl-1,4-naphthoquinone, 167, red
	1,3,5-Trinitrobenzene	122			69, 63-	215						Anthracene adduct, 164, Naphthalene adduct, 156, Fluorene adduct, 105
86	5-Bromo-1-nitro- naphthalene	122			4	213						
87	Picric acid	122										Naphthalene adduct, 149, Fluorene adduct, 84, Anthra- cene adduct, 138, n-Butyl- ammonium picrate, 151
	2,5-Dimethyl-1,3-dinitro- benzene				102-3							Reduct → 1-amino-2,5- dimethyl-3-nitrobenzene, 98
89	1-Nitro-2,4,6-tribromo- benzene	125			122	232	198					Formyl deriv of amine, 222
	4-Bromo-1-nitrobenzene 2,2'-Dinitrobiphenyl	126 124, 128			66 81	168 mono 89 90, di 161	204 mono 158- 60, di 190 1	134	180			NaOH → 4-Nitrophenol, 114 N,N'-Diformyl deriv of amine, 137
92	1,4-Dinitronaphthalene	131-2, yel			120, yel	303 4 (dı)	280 (dı)					
93 94	3,5-Dimethyl-1,2-dinitro- benzene 4-Nitroazobenzene			260	78 126	144-6	211,					Reduct → 1-amino-2,4 dimethyl-6-nitrobenzene, 76
74	4-/AILLONGODEUZEUE	135, or		> 360	120	144-0	205					

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\ m.p$ , crystal color, solvent from which crystallized

		Melting	Boiling	[			ding amine		on -		ation duct	
No	Name	point °C	point °C	Аг	nine			Benzene		Melting	Position	Miscellaneous
				Boiling point °C	Melting point °C	Acet amide	Benz- amide	sulfon amide	Picrate	point, °C	of nitro groups	
95	4-Chloro-1,5-dinitro- naphthalene	138										NaOH → 4 8-Dinitro-1-naphthol, 235 Sn + HCl → 1,5-Diaminonaphthalene, 190, PCl, → 1,4,5-Trichloronaphthalene, 131
96	2-Nitroindene	141										Zn + Ac a → 2-indanone oxime, 155
97	4-Bromo-1,5-dinitro- naphthalene	143			1							NaOH - 4,8 Dinitro-1-naph- thol, 235, HNO, At 180 - 3- nitrophthalic acid, 218
98	2,4-Dinitrostilbene	143 5, yel			119 20, pa yel							
99	1,3-Dinitronaphthalene	144 5, yel			96	263 5 (di)						
	9-Nitroanthracene	146, yel			145 50	273 4		ļ				CrO <sub>3</sub> Oxid of amine → anthraquinone 273 286, yel
	4-Chloro-1,3-dinitro- naphthalene	146 7										Warm dil NaOH → 2,4 di- nitro I naphthol, 140
102	2,5-Dimethyl-1,4- dinitrobenzene	147,			150							Reduct → 1 amino 2.5 dimethyl-4-nitrobenzene,
103	3-Nitroacenaphthene	151-2, yel			81 2	192 3	209 10		221			144 3
104	4-Nitroazoxybenzene	153, pa yel			138	151 172	ļ					
	3,8-Dinitroacenaphthene	155-6, br -yel			167 8, yel							
106	2-Nitrofluorene	156, 154			129	191						
107	3-Nitro-1,2-naphtho- quinone	156, red										SnCl <sub>2</sub> + HCl → 3-Amino 1,2- naphthohydroquinone, 164 Dil HNO <sub>1</sub> → phthalic acid, 200 6
]	2,2'-Dinitrodiphenyl- methane	159			160							Oxid → 2,2'-dinitrobenzo- phenone, 188 9
109	1,6-Dinitronaphthalene	161 2, 166,			85-6, 77	(263)	265 (d1)					
110	1,8-Dinitronaphthalene	pa yel 170, 173			66	(di)	311 2 (di)			218	1,3,8	
111	4-Bromo-1,8-dinitro- naphthalene	170, yel					()					NaOH → 4,5-Dinitro   naphthol, 235, HNO <sub>3</sub> At 180 → 3-nitrophthalic acid, 218, Al NH <sub>3</sub> → 4-amino-1,8-dinitronaphthalene, 246, red, Acetyl deriv of this, 245
	3-Nitrophenanthrene 4-Iodo-1-nitrobenzene	170-1 173			87 8 67 8	200 1 184	213 222					Gerry Of tills, 243
	1,4-Dinitrobenzene	173, 171			140. 147	304 (d1), 162 3	300 (dt), 128	247 (di)				Aq NaOH → 4-nitrophenol, 114
115	3,3'-Dinitrodiphenyl- methane	175			53-4	(mono) 193 (di)	(mono)					Oxid $\rightarrow$ 3,3'-dinitrobenzo- phenone, 155

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

				1			nding amine		on		ation duct	
		Melting	Boiling		піпе	Ι	T	i	Γ		Γ	
No	Name	point *C	point °C	Boiling point °C	Melting point *C	Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °(	Position of nitro groups	Miscellaneous
116	4-Nitrophenanthrene- quinone	179 80, pa yel										CrO <sub>3</sub> → 6-Nitrodiphenic acid, 248 50, o-Phenylene di- amine → quinoxaline deriv, 217-8, Monoxime, 169-70, Dioxime, 210, Monosemicar- bazone, 210-11
117	4-Chloro-1,8-dinitro- naphthalene	180, pa yel										NaOH $\rightarrow$ 4,5-Dinitro-1-naphthol, 235, PCl <sub>5</sub> $\rightarrow$ 1,4,5-Tri-chloronaphthalene, 131
118 119	9-Nitrofluorene 4,4'-Dinitrodiphenyl-, methane	181 2 183			64 47 93	262 236 7 (d1)	260-1					Oxid → 4,4'-dinitrobenzo- phenone, 189
120	4-Chloro-3-nitro-1,2- naphthoquinone	184, red										Aniline → 2-anilino-3-nitro- 1,4-naphthoquinone-4-anil, 250
	2-Nitroanthraquinone 2,2'-Dinitrostilbene	185 196, yel			303-6 176, golden yel	262 304 (dı)	227-8		209			
123	4,β-Dinitrostyrene	199, yel			,							Acid K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> → 4-nitro- benzoic acid, 240
124	3,3'-Dinitrobiphenyl	200, yel			94	257 8 (d1)						500 <u>12</u> 50 <b>2</b> 450 2 <b>, 2</b> 10
	2,5-Dinitrofluorene 2,2'-Dinitroazobenzene	207, yel 209-10, 194-			175 134, red	289 (dı) 271 (dı), or						
127	1,5-Dinitronaphthalene	5 yel 214 217		ı	190	360 (dı)			i	154	1,4,5	
128	4,4'-Dinitroazobenzene	217 222 3 216, or -red		i	250-1	212 (mono)						
129	2,5-Dinatrophenan- threnequinone	228, yel -										Monoxime, 190 1, o-Phenyl- enediamine → quinoxaline deriv, 262-4
130	1-Nitroanthraquinone	230			252, 243	218	255					
131	2,7-Dinitronaphthalene	234, yel			166 159	261 (dı)	267 (di)		210 (dı)			
132	4,4'-Dinitrobiphenyl	237 240			128	317 (d1), 199 (mono)	352 (d1), 203-5 (mono)					
133	1,3-Dinitroanthra- quinone	240, yel			290		>300					
134	1,6-Dinitroanthra- quinone	255-7, yel			262, red	295 (dı)	275 (dı)					
135	2-Nitrophenanthrene- quinone	258-60, yel			205-10, dk vlt							CrO <sub>3</sub> → 4-Nitrodiphenic acid, 217, Monoxime, 213, Mono- thiosemicarbazone, 234 5
136	3-Nitrophenanthrene- quinone	279-80, or										CrO <sub>3</sub> → 5-Nitrodiphenic acid, 268, Monoxime, 240, Dioxime, 200, Monosemi- carbazone, 254, red
137	2,7-Dinitroanthra- quinone (Fritzsche's reagent)	280, 262, pa vel			>330	>350 (di)	300 (di)					Ca. Jazono, 277, ICU
	reagent)	pa yel										

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

		Melting	Boiling	I			ding amine o Il nitro grou		on	Nitr. pro		
No	Name	point	point	Ar	піпе							Miscellaneous
		•c	·c	Boiling point °C	Melting point "C	Acet amide	Benz amide	Benzene sulton amide	Picrate	point °(	Position of nitro groups	
138	trans-4,4 -Dinitro- stilbene	288, yel			231, yel	353 (dı)	352 (dı)					
139	9,10-Dinitroanthracene	294 263 yel										Oxid → anthraquinone, 273 286 yel
140	1,7-Dinitroanthra-	295			290, red	283 (dı)	325 (dı)					
141	2,7-Dinitrophenanthrene- quinone	301 3, pa yel			>360, dk vlt							CrO <sub>3</sub> → 4,4 Dinitrodiphenic acid, 257 8, Monoxime, 246-8, o-Phenylenediamine → quinoxaline deriv, 356, Fluorene adduct, 270, red -yel
142	1,8-Dinitroanthra- quinone	311 2			262, red	284 (dı)	324 (dı)					1 7
143	1,5-Dinitroanthra- quinone	384-5, pa yel			319, red	317 (dı)	> 350 (dı)					Monoxime, 253

 $<sup>\</sup>bullet Derivative \ data \ given in order \ m \ p$  , crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE XXI**

Hydrolysis to the corresponding acid \*

From the nitrile and 75% sulfuric acid, or 4 1 phosphoric acid-sulfuric acid

For directions and examples see Cheronis, pp 618, 619, Linstead, p 65, Shriner, p 258, Vogel, p 410, Wild, p 250

From the nitrile and potassium hydroxide in aqueous methanol, ethanol or benzyl alcohol

See Linstead, p 65, Vogel, pp 410, 805, Wild, p 250, L Palfray, S Sabetai and S Rovira, Compt Rend, 209, 483 (1939)

From the nitrile and potassium hydroxide in ethylene glycol or glycerol

See Cheronis, pp 618, 620, S Rovira and L Palfray, Compt Rend, 211, 396 (1940)

NOTE For the directions and examples for the preparation of the derivatives of the carboxylic acid formed on hydrolysis see the explanations and references to Tables XII, XIII and XIV, pp. 186, 187, 188, 189

Partial Hydrolysis to the corresponding amide \*

$$RCN + H_2O \xrightarrow{H_2SO_4} RCONH_2$$

From the nitrile with sulfuric acid

For directions and examples see Cheronis, pp 619, 620 Vogel, p 411

Reduction to the corresponding amine \*

RCN + 
$$4[H] \rightarrow RCH_2NH_2$$
Amine

From the nitrile and sodium in absolute ethanol

For directions and examples see Cheronis, p 621, Shriner, p 259, Vogel, p 411, Wild, p 254, H B Cutter and M Taras, Ind Eng Chem, Anal Ed, 13, 830 (1941)

From the nitrile and lithium aluminum hydride in ether

See W G Brown in Organic Reactions, Vol 6 (Ed R Adams), John Wiley and Sons, New York, 1951, p 469, N G Gaylord, Reduction with Complex Metal Hydrides, Interscience, New York, 1956, pp 731-750

For summary of reduction methods see V Migrdichian, Organic Cyanogen Compounds, Reinhold Publishing Corp., New York, 1947, pp. 151-172

NOTE For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitrile see explanations and references to Table XVIII, pp 291, 292, 293, 294

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

						Deri		of the corr $N \rightarrow RC$		g acıd	Deriva		he corre  → RCH	sponding . I <sub>2</sub> NH <sub>2</sub>	amine	
No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	BP,	M P	Amide	Anılıde	S-Benzyl thru ronrum chloride	Amine BP °C	Benz- amide	Ben zene sulfon amide	Phenyl thiourea	Picrate	Miscel laneou
<u></u>	Cyanoacetylene	42 5	5	1 386991	0 81591	144d , 83 4 °	18	61 2	87	cinoriae			annuc			HgNO <sub>3</sub> Wh pi cipitat Dimer
2	Cyanoacetalde- hyde	71 2			0 881						45 61					64 5 - 5 HNO <sub>3</sub> Cyano acetic acid, 6 2,4-D nitro pheny hydra zone, 170 I aq al Nitro- pheny hydra
3	Acrylonitrıle	77 8		1 39320	0 797∜	140	13	85	105							zone, 153-4 Gives si polym on add tion o conc NaOM
4	Fluoroaceto- nitrile	80				165	33	77								sol
5	Acetonitrile (Cyanometh- ane)	81-2		1 344220	0 782840	118		82	114	135	16 5	71	58	106, 135	165	
6	Trichloroaceto- nitrile	86, 83 4			1 43912	196 7	58	141	95-7							
7		90 i		1 399 25	0 7991 '*	160	15 6	102 6								Gives so polymon hear ing will benzo
8		97,	!	1 365925	0 777‡	141		79	106	151	49	84	36	63	135	регох
9	(Cyanoethane) Isobutyronitrile	103 5 104, 107 8		İ	0 773	154 3	-47	129	109	143	69	57	53	82	150	
10	Trimethylaceto- nitrile (tert- Butylcyanide)	106	15-6	1 3792			35	153 4	127-9							
11	2-Ethylacrylo-	111		1 4132		180		84, bz								
12	nitrile Dichloroaceto- nitrile	113			1 374115	194	5 6	98								Me est of acid
13	α-Chloroiso- butyronitrile	116		1 4045 <sup>25</sup> ,	1 064		31		69 70							143-4
14	n-Butyronitrile (1-Cyano- propane)	117		1 381224	0 7961	162		116	96	146	77			65	151	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

						Der		of the corr		g acıd	Deriva		he corre	sponding :	amine	
No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	A	cıd			S-Benzyl thiu	Amine	Benz-	Ben- zene	Phenyl		Miscel- laneous
						BP,	MP,	Amide	Anilide	ronium chloride	BP,°C	amide	sulfon- amide	thiourea	Picrate	
15	trans-Crotono- nitrile	119		1 4217		189	72	158	115		83 4			109 5- 10 5	131 5- 2 5	ng of amine 1 4263, 1-Naph- thylthio- urea of amine,
16	Allylcyanide	119		1 406020	0 83515	169,		73	58	75 7				123 7, 56 7	136 8	129 30 nβ of amine 1 4191, Al KOH → cro- tonic ac, 72 1- Naph- thylthio- urea of amine,
17	, ,	120		1 38028	0 937328	203-4		96	58							109 10
18	nitrile 2-Hydroxyiso- butyronitrile (Acetone cyanohydrin)	120d	-19	1 399620	0 93‡⁰		79	98	136							
19	3-Hydroxy-4- methoxybenzo- nitrile	124 131 5- 2 0					255 7	7.7.7.								Acetate, 116, Ace- tate of acid, 206-7, Me ester of acid, 83 4,
20	2-Methylbutyro- nitrile	125 6		1 380 <sup>25</sup>	0 80612	177		112	110		95 5- 6 0					66-7 HCl salt of amine, 176, H <sub>2</sub> PtCl <sub>6</sub> salt of amine,
21	Chloroaceto- nitrile	127			1 19320	189	63	120	137						142-3	240 Addition comp with AlCl <sub>3</sub> , 38, HCl salt of amine,
22	Isovaleronitriłe	130			0 7884%	176		136	113, 109 10	153	96			102	138	144 3-Nitrohy- drogen phthalate of amine,
23	2,4-Pentadieno- nitrile	135-8		1 4880	0 8444		72	124								108 Me ester of acid, 50 220

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

						Den		of the corre		g acıd	Deriva		he corre	sponding a	amine	
No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	A	cid			S-Benzyl thiu	Amine	Benz-	Ben- zene	Phenyl		Miscel- laneous
						BP, °C	M.P., °C	Amide	Anılıde	ronium chloride	BP,°C	amide	sulfon amide	thiourea	Picrate	
24	2-Chlorocro- tononitrile	136				212, 85 95 <sup>10</sup>	99	212			128 31				191	Me ester of acid, 161, HCl salt of amine,
25	Ethoxyaceto- nitrile	136 7758				156 716		80 2			108750				121 3	amine l 4108, Et ester of acid,
26	2-Methylcro- tononitrile	138		1 4319	0 8313	198 5	64	75 6	77							b p 152 p-Tolui- dide of acid,
27	2-Bromoiso- butyronitrile	139-40		i 445 <sup>25</sup>			48-9	148	83	<u> </u> 						70 5-1 5
28	4-Pentenonitrile	140	:	1 421314	0 848¦ţ	188-9		94		91 <b>4</b> , 98						H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 166, Thiourea deriv of amine,
29	Thiophene-2,3- dicarbonitrile (2,3-Dicyano- thiophene)	140					272-4	dı 228								43 5-4 0 D <sub>1</sub> -Me ester of acid, 32 3
30	3,3-Dimethyl- acrylonitrile	140 2			0 829214	199	70	107-8, 65 6	126 7		105 8			105 0 5 5	139- 40d	HCl salt of amine,
31	Valeronitrile (1- Cyanobutane)	141		1 399115	0 803545	186		106	63		104			69	139	193-4
32	2-Chlorobutyro- nitrile	143				189627		75 5 6 0	74 5					   	142, 124	
33	Diethylaceto- nitrile	145				190		107			71 5				168-9	
34	2-Furanecarbo- nitrile (α-Furo- nitrile, 2- Cyanofuran)	147		1 479820	1 082220		133 4	142	124	211	145 6				150	
	2-Methylaceto- acetonitrile	147, 145 6		1 423920	0 97944°	224 <sup>34</sup>	73	138-40	112 5-		110753					Semicar- bazone, 153, p- Nitro- phenyl- hydra- zone, 147 HCl salt
<i>5</i> 0	carbonitrile (Cyanocyclo- butane)					173		155	30		110.00					of amine, 235 5

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

						Deri		f the corre		g acıd	Deriva		he corre → RCH	sponding a	amine	
No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/mi	BP,	m P ,	Amide	Anihde	S-Benzyl thiu ronium	Amine	Benz amide	Ben zene sulfon-	Phenyl thiourea	Picrate	Miscel- laneous
						°c,				chloride	BP,°C	aimac	amide	tinoarea		
37	2-Chloro-3- methylbutyro- nitrile	154-5			0 992212	210-2, 126 <sup>32</sup>	37 9							-	137-8, 160	Et ester of acid, b p 178-9, HCl salt of amine, 190d, H <sub>2</sub> PtCl <sub>6</sub> salt of amine,
38	Isocapronitrile (4-Methyl- pentano	155		1 408514	0 807¼	199 4	-33	119, 121	111-2		125			- Company of the Comp	123 5	193 5
39	nitrile) 2,2-Dimethyl- acetoaceto-	163 4			1 00813	1031		121								Oxime, 99-100
40	nitrile 2-Methyl- hexanonitrile	165		1 4070	0 7985	210		72	98		45- 5415		į			
41	3-Methoxy- propionitrile	165		1 4032	0 936745	10710		50			120					
42	n-Capronitrile (n-Hexano-	165	-80 31	1 411520	0 8093⅔	205		100	95		130	40	96	77	126	HCl salt of amine
43	nitrile) (Ethylamino) acetonitrile (N- Ethylglycino- nitrile)	166 7 81 3 <sup>24</sup>	1				180-2				126-9	dı 117- 8			di 194 5	219 HCl salt, 141 2
44	d,l-3-Methyl- hexanonitrile	171-2749		1 4143	0 8109	212 3 55		99 100			148 9 <sup>756</sup>					p-Tolui- dide of acid, 73 4, n <sup>20</sup> of amine,
45	Chlorofumaro- nitrile	172 6410		1 4957120	I 2499 <sup>20</sup>		191 2		di 186					=	-	0 7787 Di-Me ester of acid, b p
46	2-Acetoxy- propionitrile (O-Acetyl	172 3	THE PARTY AND TH			167 7078	57 60									H <sub>2</sub> PtCl <sub>6</sub> salt of amine,
47	lactonitrile)   3-Ethoxypropio- nitrile	173	7738	1 4068	0 918945	11919		50			138					207 9 ng of amine, 1 4242, Dg of amine,
48	3-Chlorobutyro- nitrile	176			1 0772°	10114	43 4 5		89 90						147	0 8697 H <sub>2</sub> PtCl <sub>6</sub> salt of amine,
49	3-Chloropro- pionitrile	178			1 144318	204	41		119, w							p-Tolus- dide of acid, 121 HCl salt of amine, 146-8

<sup>\*</sup>Derivative data given in order im pi, crystal color, solvent from which crystallized

		Boiling	Melting			Der		of the corr CN → RC		g acid	Deriva		the corre	sponding I <sub>2</sub> NH <sub>2</sub>	amine	
No	Name	point °C	point °C	n <sub>D</sub>	Density g/ml	A	cıd			S Benzyi thiu	Amine	Benz	Ben zene	Phenyl		Miscel- laneous
	<u>'</u>					B P °C	M P °C	Amide	Anilide	ronium	вр °С	amide	sulfon- amide	thiourea	Picrate	
50	Indole-3-car- bonitrile (3 Cyanoindole)	178 rose				208										N Acetyl deriv 202 Et ester of acid 82 M p of amine 84
51	5-Methyl- hexanonitrile	178 80				216		104	75	149 5						Me ester of acid, b p
52	carbonitrile (3 Cyanothio	179 203 5		1 556521	1 195620		138	180								166 7
53	phene) d l-4-Methyl- hexanonitrile	180		1 4144	0 8141	217 8		98			152 3 <sup>50</sup>					n <sub>D</sub> <sup>20</sup> of amine, 1 4238, D <sub>4</sub> <sup>20</sup> of amine, 0 7802
54	d l-Lactonitrile (Acetaldehyde	182 4		1 405815	0 9877‡"	122'	18	79 75 6	59	153	161 2				142	0 /802
55	cyanohydrin) Glycolonitrile (Formaldehyde	183 sl d					80	120	97	141 146 7	171				160	Benzoyl deriv
56	cyanohydrin) Heptanonitrile	183 187			0 8107%	223		95	71		155			75	121	195 6
57	4-Cyanoheptane	183-4				221 2		123 4			167					Et ester of acid b p 183 H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 211 d
58 59	Benzonitrile Thiophene-2- carbonitrile (2- Cyanothio- phene)	190 192	-13	1 5289 <sup>20</sup> 1 5641 <sup>15</sup>	1 0102¦3 1 1800¦5		122 129 30 192	129 180	162 140	167	184 5 58 <sup>5</sup>	105	88	156	194 181 2	HCl salt of amine, 193 4
<b>6</b> 0	2-Octynonitrile	194 6			ĺ	148	f p 2 5	91	44							
61	4-Chlorobutyro- nitrile	196 7			1 16210	196**	16	88 9	60 70, bz - pet eth							

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

						Der		of the corr		g acıd	Deriva		he corre	sponding	amine	
No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub>	Density g/ml	A	cıd			S-Benzyl thru-	Amine	Benz-	Ben zene	Phenyl		Miscel- laneous
						BP, °C	МР, °C	Amide	Anılıde	ronium chloride	ВР, ℃		sulfon- amide	thiourea	Picrate	
62	Methyl cyano- acetate	200,	-225	1 417025	1 096245						5815					Hydrolysis  → malo- nic acid, 135, HCl salt of amine, 102 5, H₂PtCl <sub>6</sub> salt of amine, 192, NH <sub>1</sub> → Cy- anoaceta-
63	Dibenzyl acetonitrile	200 15	İ			1	89	128 9	155							mide, 118
64	2-Tolunitrile (2- Methylbenzo- nitrile)	205	-13	1 527225	0 991225		104	140	125	146	208	88			215	Acetyl deriv of amine, 69
65	2,3,3-Trimethyl- 1-cyclopentene- 1-carbonitrile (β-Cam- pholyto- nitrile)	205, 225			0 912715	255-6	135	130, al	104, aq al		205 5 6 5				178	Et ester of acid, 222 5, HCl salt of amine, 175-6
66	Caprylonitrile (Octanonitrile)	206, 199		1 4224 he	0 8172 12	239	16	110	57		180				112	
67		206 <sup>756</sup> , 90-1 <sup>20</sup>			0 951511		111 5	di 216								Dihydra- zide of acid, 168, al
68	Ethyl cyano- acetate	207		1 417920	1 05647				198 9							NH, → Cyano- acet- amide, 118
69	1,1-Dicyano- butane (Propyl	210750			0 92241*		96	dı 184	dı 198							
70	malononitrile) 3-Tolunitrile (3- Methylbenzo- nitrile)	212	-23		1 031620		113, 110	95	126	140	207				198, 156	Acetyl deriv of amine, 150
71	Cyclohexyl- acetonitrile	215		1 45718	0 913 18	244 6	33	171-2			188-9	79-81			155 6	HCl salt of amine, 252-3, ng of amine, 1 4625
72	4,4-Dicyano-1- butene (Allyl malononitrile)	217-8	f p -12				105, eth									D1-Et ester of acid, b p 222 3, p-Nitro-benzyl ester of acid, 46, al

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

		Boiling	Melting			Der		f the corre		g acid	Deriva		he corre → RCH	sponding a	amine	
No	Name	point,	point °C	n <sub>D</sub>	Density g/ml	А	cıd			S-Benzyl thiu	Amine	Benz-	Ben- zene	Phenyl		Miscel laneous
					_	B P °C	M P °C	Amide	Anilide	ronium	вР,°С	amide	sulfon- amide	thiourea	Picrate	
73	3-Isopropyli- dene-1-methyl- cyclopentane-1- carbonitrile (β- Fencholeno- nitrile)	217 9			0 9203' '	259	72 3	86 5 7 5								Me ester of acid, 97-9
74	3-Hydroxy- propionitrile	220			1 059"	d	syrup				188				222	Sodium salt of acid, 143, P₂O₅ → acrylo- nitrile, b p 77
75	1,1-Dicyano-3- methylbutane (Isobutyl malononitrile)	222					108, bz	<i>dı</i> 195 6, al					į			
76		224	-34 2	1 42522	0 82211	255	15	99	57		201	49			111	Acetyl deriv of amine, 34 5
77	2-Phenylero- tononitrile	224 6		1 5555	1 013		136	98 9								
78		229 7 220			1 059"						107 8 <sup>26</sup>				130, 222	Me ester of acid, b p 177 84 H <sub>2</sub> PtCl <sub>6</sub> salt of amine,
79	2-Phenylpropio- nitrile	232				265 8		97 5		210					182	Me ester of acid, 221, Mp of amine, 85 HCl salt of amine, 123 4, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 229d
80	Phenylaceto- nitrile (Benzyl cyanide)	234		1 52112	1 0214		76 7	157	118	163	198	116	69	135	174, 167	229 <b>u</b>
81		239 40			1 091	285	98 9	101 5			228				167 8	HCI salt of amine, 215, HBr salt of amine, 192-3

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

						Der		f the corr		g acid	Deriva		he corre	sponding I <sub>2</sub> NH <sub>2</sub>	amine	
No	Name	Boiling point *C	Melting point °C	n <sub>D</sub>	Density g/ml	A	cıd			S-Benzyl thiu	Amine	Benz	Ben- zene	Dhami		Miscel- laneous
						B P	MP,	Amide	Amilide	ronium	B P , ℃	amide	sulfon- amide	Phenyl thiourea	Picrate	
82	4-Hydroxy- butyronitrile	240			1 029*	204					205 6					Acid forms readily butyro-lactone, b p 204, CrO <sub>3</sub> + butyro-lactone → succinic
83	(3-Tolyl)aceto- nitrile (m- Xylylcyanide)	240			1 002222	120- 326	61	141			214				176	acid, 186 Et ester of acid, b p 237 8, HCl salt of amine,
84	(4-Tolyl)aceto- nitrile (p- Xylylcyanide)	242 3	18	1 51532	0 992222	265-7	94	185			214 5	95 6			155	Et ester of acid, b p 240, HCl salt of amine,
85	4-lsopropyl- benzonitrile	243- 4 <sup>34</sup>				Total Control of the	117 8, al	153,			227 21					216-7 Et ester of acid, b p 263 4 HCl salt of amine,
86	(2-Tolyl)aceto- nitrile (o-Xylyl cyanide)	244			1 015622		88 9	161			215 5 7 0				177	239-40 HCl salt of amine, 227-8
87	Decanonitrile	245		1 4320 He	0 82941	269	31	100,	70							
88	3-Methyl-2- phenylbutyro- nitrile	245 9 '		1 50382	0 9671	159 6014	61 2	111 2	132 3		155- 6 <sup>24</sup>					HCl salt of amine, 128
89	1,2-Dicyano- propane (Methyl suc-	252 4	12				115	di 225	dı 200		172 3	154				HCl salt of diamine, 144-5
90	cinonitrile) 1-Undecano- nitrile (1- Hendecano- nitrile)	253 4	II provide della companyation de			1641	28 2	980 7	71						1.4	Hydrazide of acid, 101-2, Phenyl- hydra- zide of
91	2-Phenylvalero- nitrile	254-		1 5000	0 96017	280	58	83 5			90 <sup>3</sup>					acid, 110
92	10-Undeceno- nitrile (10- Hendeceno- nitrile)	257, 129- 30 <sup>14</sup>		1 4442 20	0 84434	274	24 5	87								

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

						Det		of the corr		ng acid	Deriva		he corre	sponding	mine	
No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	A	cıd			S-Benzyl thru	Amine	Benz	Ben zene	Phenyl		Miscel- laneous
						B P	M P °C	Amide	Anilide	ronium chloride	BP C		sulfon- amide	thiourea	Picrate	
93	3-Phenylpropio- nitrile	261			1 001418	280754	48 5	105	98		221 5""	57 8			152-3	HCl salt of amine, 218, H <sub>2</sub> PtCl <sub>6</sub> salt of amine,
94	<b>2-Cyanobenzal</b> chloride (α,α-Dichloro- <i>o</i> -	261					155, bz	117								233
95	tolunitrile) N-Methylani- linonitrile (N- Cyano-N-	266	13				95 100	163				İ				Picrate, 195
96	methylaniline) 3-(2-Chloro- phenyl)propio- nitrile	267 8		1 5390	1 139020		96 5, w	119 bz								Me ester of acid, 255 HCl salt of amine,
97	1,3-Dicyano-2- methylpropane (2-Methyl- glutaro- nitrile)	269 71				205	79	dı 175 6			7811					167 Di-p-toluidide of acid, 174 5, n <sub>D</sub> of amine,
98	O-Benzoyl lacto- nitrile (Lacto- nitrile ben zoate)	269-70					112	124								l 4585 Di-p-nitro- benzyl ester of acid,
99	3-Cyanobenzał chloride ( $\alpha, \alpha$ Dichloro- $m$ -tolunitrile)	272 5					132									119 5
100	<b>4-Cyanobenzal chloride</b> (α,α-Dichloro-p-	273 6 <sup>77</sup> °					151 8									Et ester of acid, 45 6
101	tolunitrile)  Dodecanonitrile (Lauronitrile)	276 7	4	1 43595	0 827315	225	44	110 102, aq al	78	141	247 9					M p of amine, 28 3 Acetyl deriv of amine, 68 5 9 5, bz. p-Toluene-sulfonyl deriv of amine, 73
102	1,3-Dicyano- propane (Glutaro- nitrile)	286		1 436523	0 995¦5		97	175	224		178 80	dı 135	119	148	237	

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\,$  m  $\,$  p  $\,$  , crystal color, solvent from which crystallized

						Der		f the corr N → RC		g acid	Deriva		he corre-	sponding a	imine	
No	Name	Boiling point	Melting point	n <sub>D</sub>	Density g/ml	A	cıd			S-Benzyl	Amine	B	Ben-	Dhamil		Miscel laneous
		.c	·c			B P *C	M P	Amide	Anilide		BP 'C	Benz amide	zene sulfon amide	Phenyl thiourea	Picrate	
103	4-Methoxyhy- drocinnamo- nitrile (3-(4- Methoxy- phenyl)- propionitrile)	290–300					1045	125			118 20 <sup>2</sup>					Me ester of acid, 38, M p of amine, 65 7-6 3, HCl salt of amine,
104	1,4-Dicyano- butane (Adipo- nitrile)	295	0-1	1 459720	0 951   4		153, 150	220	239		204 5	dı 155	di 154		220	220 5 M p of amine, 42

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE XXI. ORGANIC DERIVATIVES OF NITRILES a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)\*

		Boil-	Melt-			De		of the corr		acid	Deriv		the corre	esponding	amine	
No	Name	ing point,	ing point,	n <sub>D</sub>	Density g/ml	Α	cid			S-Benzyl thru-	Amine	Benz-	Ben- zene	Phasul		Miscel- laneous
		°C	,c			BP, °C	МР, °C	Amide	Anılıde	ronium	B P °C	amide	sulfon- amide	Phenyl- thiourea	Picrate	
	1,2,2,3-Tetramethyl- 3-cyclopentene-1- acetonitrile (5- Methyl-a-cam- pholenonitrile)	115 918			0 92174*	1 512	35 6 7 0	99 100, lgr								
3	1-Cyanocyclo- hexene 2-Hydroxybutyro- nitrile (Propanal cyanohydrin)	102- 3 <sup>23</sup>		1 481825	0 9621	238 40 <sup>63*</sup> 225 60d	38	127 8	89 90		55 7 <sup>12</sup> 172 <sup>755</sup>	112 1			181	N,O-Di-p nitro- benzoyl deriv of amine, 1192,
	Hydnocarponitrile	155 6 <sup>2-3</sup>		1 455925	0 858025		59 60	108 5d				į				Acetate, 43, CS <sub>2</sub>
5 6 7	α-Chloro-α-phenyl- acetonitrile Butyl cyanoacetate 3-Bromopropio- nitrile	131- 5 <sup>18</sup> 115 <sup>15</sup> 69 <sup>7</sup>		1 4243 <sup>25</sup> 1 4789 <sup>25</sup>	0 99825		60 1 66 62	116	198-9						154, yel	Nitrile + alkalı →
0	2,4-Diphenylbutyro-	152				190'	72 3,	96								acrylic acid, p- toluidide of which, 141
9	nitrile Thiophene-2-aceto- nitrile	61 115 20 <sup>22</sup>		1 539925	1 15345	190	76 76, 63-4	146 7			72-43	61, bz - Igr		109 5 10		HCl salt of amine, 202 4, N-Acetyl deriv of amine,
10	trans-4-Chloro-	61- 1 411		1 4705	1 1207	117 8 <sup>13</sup>	83	130-2			ļ					45 5 6 5
11	2-Cyanopentanoic acid	125- 30 <sup>92</sup>		į			96	di 184	dı 198							Amide of nitrile, 124 5, Annide of nitrile, 88-9
ŀ	Azelaonitrile (1,7- Dicyanoheptane) 3-Chloro-2-hydroxy- 2-methylpro- pionitrile (Chloro-	183 <sup>11</sup> , 160 <sup>3</sup> 110 <sup>22</sup>		1 4426 <sup>25</sup> 1 4520	1 202715	230-5	106 110	di 175	dı 186-7		258-9					M p of amine, 37
14	acetone cyano- hydrin) 1,11-Dicyanounde- cane (1,11-Di- cyanohendecane)	189 90 <sup>7</sup>					111-2	dı 175 6	mono 112 5- 3 0, di 160 1							M p of amine, 58 HCl salt of amine, 254 5, al

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

#### TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)\* (Continued)

		Boil	Melt			De		of the cor CN → RC	responding OOH	acid	Den	vatives of RCN	the corre	sponding	amine	
No	Name	ing point	ing point	n <sub>D</sub>	Density g/ml	A	cid			S-Benzyl thiu	Amine	Benz	Ben	DL		Miscel- laneous
		,c	.c			B P °C	M P	Amide	Anilide	ronium	B P °C	amide	sulfon amide	Phenyi thiourea	Picrate	
15	2-Cyanobutyric acid	15315					1115	212 4								'Hydrazide of acid, 95 6, Amide,
16	2-Cyanobiphenyl	17215					114	177								113 Acid + conc H₂SO, → fluore- none, 83
17	1,12-Dicyanodode- cane (α,ω-Dode- cane dicyanide)	225 8 <sup>17</sup>					129, w	di 189	di 191, 170 1							Di-p-tolui- dide of acid 165 M p of amine, 61 5 HCl salt of diamine, 309 10
18		116 811		1 4978	0 9439	164- 510	132 3	164 5								309 10
19	penylcyclohexene Sebaconitrile (1,8- Dicyanooctane)	201 3 <sup>16</sup>				,	134	di 210	di 198				į			M p of amine 60
20		18012		1 444822			141	dı 216 7	dı 186 7		240 1 225 6	dı 121 2			<i>dı</i> 180	M p of amine, 52
21	3-Cyanoindene (Indene-3-car- bonitrile)	140 2 <sup>13</sup>					161, 156-7	180	158		U					Hydrazide of acid, 186
22		58 <sup>15</sup> , part d					262 d	65-6	62 (+2 H₂O)		116 5	dı 244	<i>dı</i> 168		di 233 5	HCl salt, 165 5 6 5, M p of amine, 8 5

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

				ı	Derivatives (	of the corre		acıd		atives of th			
No	Name	Melting	Boiling		Acid			S Benzyl	Amine	B	Ben zene		Miscellaneous
		C	С	B P C	M P °C	Amide	Anilide	thiu ronium chloride	B P C	Benz amide	sulfon amide	Picrate	
1	2 Cyanodiphenyl- methane	19	313 4		117	163							
2		19	210		215 7				182 3 58 61			di 225 220 1	Methiodide 192 3 HCl salt of acid 215 6 Phenylthiourea deriv of amine 92 3
3	3-Chloro-2-tolunitrile	19	10728		159 154				l				
5	Tetradecanonitrile Cinnamonitrile	19 20 20	255 6		54	103 153 109	82 147	175 179				181 yel	M p of amine 37 HCl salt of amine 235
6 7	Trichloroacrylonitrile DL-Mandelonitrile (Benzaldehyde cyano hydtin)	20 22			76 118 9	97 8 87 133 4	98 151 2 146		116 7	148 9		aq al 153 4 al	n <sub>D</sub> 1 5100 Mp of amine 56 5 8 0 O Benzovl deriv 63 4 3 Nitrobenzovl deriv 83 4 p Toluidide of acid 174 HCl salt of
8	Pentadecanonitrile	23	322		52	102	78	ļ	299 301				amine 208 19 acet M p of amine 34 0 6 5 HCl salt of amine 199 N Acetyl deriv of amine 72
9	2-Methoxybenzonitrile	24 5	255 6		00 1	129	131		226 8			İ	H PtCl <sub>6</sub> salt of amine
10	(2-Chlorophenyl) aceto- nitrile (2 Chlorobenzyl cyanide)	25	251		95	175 w	138 9		105 8 4			187 bz	
11	1,1-Dicyanoethane (Methylmalononi	26			135 138 d	di 217	di 182					<i>dı</i> 252 d	Di p toluidide of acid 227 8 Di HCl salt of
12	trile) 2-Cyanopyridine (2 Pyridinecarbonitrile Picolinonitrile)	26	212 5		136 7	106 7	76		95 8²			159 60 d	amine 201 HAuCl <sub>4</sub> salt 190 N Acetyl deriv of amine 59 60 bz pet eth Oxalate salt of
13	4-Toluntrile (4 Methyl benzonitrile)	27 29	217		179 80	155 165	147 8		80°	137		205 15 d	amine 166 7 d D' 0 9805 M p of amine 13 N Acetyl deriv of amine 107 8
- 1	D-Mandelonitrile d l-(2-Bromophenyl) acetonitrile (2 Bromo benzyl cyanide)	28 9 29	170 d 242 d		133 84	123 143 4 144 8						150 1	[\alpha]\frac{1}{3}\text{in} + 46 9 \text{ in bz}  Et ester of acid b p  150 2 \(^3\text{ M p of amine}\)  163 4 HBr salt of amine 163 4
16	(4-Chlorophenyl)aceto mtrile (4 Chlorobenzyl cyanide)	30	265 7		105	175	164 5		114 615			212	HCl salt of amine 218 0 8 5 p Toluene sulfonate derive of
17	Malononitrile (Methyl	30	218 9	i	135	170			136	140	96	250	amine 235 n <sub>D</sub> <sup>34</sup> 1 4146 N Acetyl
	ene cyanide)  Hexadecanonitrile  Maleonitrile (cis † 2  Dicyanoethylene)	31 31			63 130	106 7 181	90 187	163 173	163 70	178 5	dı 155	<i>dı</i> 250 d	deriv of amine 126 D <sup>31</sup> 0 8224
20	2,2-Dicyanopropane (Dimethylmalono nitrile)	31 2	169 5 subl		192 3 subl part d >130	dı 269	203 4	159 60	153	9 5 di 152	ał		Di Me ester of acid b p 177 <sup>75</sup> HCl salt of amine 256 7

<sup>\*</sup>Derivative data given in order m p crystal color solvent from which crystallized

		Melting	Boiling	D	erivatives o	f the corres		acıd		ives of the			
No	Name	point,	point,	1	Acıd			S-Benzyl	Amine	B	Ben-		Miscellaneous
		°c	*c	BP.	M P °C	Amide	Anilide	thiu- ronium chloride	<b>ВР</b> , <b>°</b> C	Benz- amide	zene sulfon- amide	Picrate	
21	tert-Butylacetonitrile (Neopentyl cyanide)	32-3	138	186 8		132	131						HCl salt of amine, 158 60, subl
22	1 ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '	33			131	154, 180							
23	4,4-Dicyanoheptane (Dipropylmalono- nitrile)	33 4 (anh) 49 50 (hyd)	223-4, 135- 40° ²		161	di 214	di 168 0 5, me al		13225	dı 154			
24	Heptadecanonitrile	34			61	106	1		335-40	91			M p of amine, 49, N-Acetyl deriv of amine,
25	1-Naphthonitrile (1- Cyanonaphthalene)	34, 37	299		162	202			15512		148	223	N-Acetyl deriv of amine, 134, lgr Methiodide deriv of amine, 213, al
26	2-Cyanopropionic acid	35	142 511		135, 120	dı 206	di 182. 214						Amide, 105 81 Mono-p-toluidide of acid, 145 d Di-p-toluidide of acid, 227 8 245
27 28	4-Fluorobenzonitrile Coumarilonitrile (Cou- marın-2-carbonitrile)	35 36	189-90	310- 5, sl d	183 192-3, w	154-5 159	159		183			203	Et ester of acid, 27 Ph ester of acid, 101
29	Indole-3-acetonitrile	360 5	157° ²	si u	164-5 199	150 1	149 5 50			137 8		247 d	Me ester of acid, 135 Mp of amine, 116 7, 146 HCl salt of amine, 248 9 N-Acetyl deriv of amine, 77, pet eth
30 31	3-Bromobenzonitrile 2-(N-Anilino)-butyro- nitrile	38 39	225		155 141	155 123, w	92, al		244-5	135 6		205	Et ester of acid, 26
32	trans-o-Chlorocinnamo- nitrile	40			212, yel, al	168	176						Me ester of acid, b p 278 9
33 34	Octadecanonitrile 3-Chlorobenzonitrile	41 43 41			70 158, 155	109 134	95 88 122-5		110-217	314		203	
35	2-Chlorobenzonitrile	43	232		141	142	118		103-411			217	N-Acetyl deriv of amine, 79-80
36	4-Chloromandelonitrile	43			119-22, 112-3	122-3							O-Benzoyl deriv, 57-8  Me ester of acid, 85 8, bz-pet eth
37		43			69	109 5 8	95 5- 6 5						Me ester of acid, 39 5 40
	2-Bromo-4-tolunitrile 3,3-Dicyanopentane (Diethylmalononitrile)	44 44-5	195, 9224		204 125, w	mono 146,							
40	4-Cyanobutyric acid	45			97 8	di 224 182-3	dı 221 2			105			Amide, 69 70 Et ester of acid, b p 245 M p of amine, 157 8, HCl salt of amine, 92-4 HAuCl <sub>4</sub> salt of amine,
41 42	5-Chloro-2-tolunitrile (4-Aminophenyl)aceto- nitrile (4-Aminobenzyl cyanide)	45-6 46	312		169 199	161 2							86 7, 106 Me ester of acid, 30-1 N-Benzoyl deriv, 176-7, Picrate, 185
43	meso-2,3-Dimethyl- succinonitrile	46			209, 198 d	dı 310-3	dı 235						Di-Me ester of acid, bp 198 9

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		Melting	Boiling	t	Derivatives (	of the corre		acıd		tives of th			
No	Name	point,	point,		Acıd			S-Benzyl	Amine		Ben-		Miscellaneous
		°C	°C	BP. °C	M.P., °C	Amide	Anılıde	thiu- ronium chloride	BP, °C	Benz- amide	zene sulfon amide	Picrate	
44 45	}	47 47			140 114, subl	137 192 4		-					Et ester of acid, 30, HCl salt of amine, 240-3
46 47	N-Anılinoacetonitrile 3-Cyanopropionic acid	48 lgr 48 50			127 8 235	136 185	113 mono 157, di 269 d	mono 148 5, di 230		79 80			Amide, 97, Me ester of acid, b p 215, Di-p-toluidide of acid, 256, M p of amine, 193 203 d, HCl salt of
48 49	3-Chloro-4-tolunitrile 3,3-Diphenylacrylo- nitrile (β-Phenyl cinnamonitrile)	48 50 49			200 2 162, 167		130 1						amine, 135-6, 95-6 Me ester of acid, 28
50	3-Bromo-2-hydroxy benzonitrile	49-50			184	165							
51	<b>4,4-Dicyanoheptane</b> (Dipropylmalono- nitrile)	49-50 (hyd), 33-4 (anh)			161	dı 214	ds 168 0- 5, me al		13225	di 154			
52	trans-2,3-Diphenyl- acrylonitrile	49-51	213 423		172	127, acet	141, al						
53	Eicosanonitrile	49 5			77, 75 2		92		196 24 0				M p of amine, 57 8, n <sub>0</sub> <sup>70</sup> of amine, 1 4341
54	3-Cyanopyridine (Nicotinonitrile)	50	240-5		232	122	85, w , 132, bz - lgr		88-90²	132		<i>tri</i> 206 8	HAuCl, salt of amine, 196-8, Di-HCl salt of amine, 224
55	( <b>4-lodophenyl)aceto- nitrile</b> (4-lodobenzyl cyanide)	50-1		-	135								HCl salt of amine, 294 6 d
56	4-Cyanodiphenyl- methane	51			157 8								Acid CrO <sub>3</sub> 4-Benzoylbenzoic acid, 197-200, al
57	2-(N-Anilino)-valero- nitrile	51, pet eth			147-8, al	99, eth - pet eth							
58	2-Aminobenzonitrile (Anthranilonitrile)	51, yel, CS <sub>2</sub>	267 8777		147	109-11	130-1			167			Et ester of acid, b p, 266-8, p-Toluidide of acid, 151
59	2-Bromobenzonitrile	53	253		150	155-6			1189				HCl salt of amine, 241,
60	5-Cyanothiazole	53			218	186							Me ester of acid, 68-9, N-Acetyl deriv of amine, 159-60
61	3-Aminobenzonitrile	53-4, aq al	288-90		174	78 9	114						N-Acetyl deriv, 248, Me ester of acid, 36-8, Et ester of acid, b p 294, Fe/AcOH Ben- zonitrile, b p 190 + NH <sub>3</sub>
62	2-Quinolinoacetonitrile	53 4	1401		274-5				138- 40 <sup>7</sup>			dı 202	Picrate, 176-7d, Me ester of acid, 72, Igr
63	2-Iodobenzonitrile	55			162	184				154			HCl salt of amine, 248- 50, N-Acetyl deriv of amine, 134-5

<sup>\*</sup> Derivative data given in order |m|p , crystal color, solvent from which crystallized

		Malera	<b>D</b> ouble	r	erivatives o RC	f the corres N → RCO		ıcıd		ives of th			
No	Name	Melting point, °C	Boiling point °C	ВР	Acid M P	Amide	Anilide	S Benzyl thru ronium	Amine B P	Benz- amide	Ben- zene sulfon	Picrate	Miscellaneous
				.c	°C			chloride	,c	annue	amide		
64	2,4,6-Trimethylbenzo- nitrile	55, bz	225 30		155, lgr	187 8			98 5 100°	153 4			Me ester of acid, b p 241 2 <sup>-18</sup>
65	α-Aminobenzyl cyanide	55			256	130 2, al			13519	dı 223 5			N-Acetyl deriv, 130-8, et ac pet eth N Benzoyl deriv, 151 Picrate, 160-1, yel
66	Cyanoform (Tricyano methane)	55 6 pet eth				i							NH₄ salt, 183
67	Succinonitrile	56 6	265 7		186 8	260	230	149	159	177		250 5	M p of amine, 27 N- Acetyl deriv of amine
68	2-Iodo-4-tolunitrile (2- Iodo-4-methylbenzo- nitrile)	57-8			205 6	167						-	
69	2,6-Dinitrobenzonitrile	58 (145)			202 3								Me ester of acid, 147 Mp of amine, 88, HCl salt of amine, 185, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 193
70	d.l-2,3-Dimethyl- succinonitrile	58 9			135	mono 148 9, di 244	dı 222						Di-Me ester of acid, bp 200
	2-Chloro-4-tolunitrile 4-Methoxybenzonitrile	61 2 61 2	256 7		155 6 184 6	182 162 3	169	177	236 7				N-Acetyl deriv of
								184 5				}	amine, 96, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 210
73	2,4-Dichlorobenzonitrile	61-2			164 160	194			140122				Me ester of acid, b p 132 <sup>15</sup> , n <sub>D</sub> <sup>25</sup> of amine 1 5738, HCl salt of amine, 281 2 4 3
74	4-Methoxycinnamo- nitrile	64			170	186							Me ester of acid, 90 Et ester of acid, 49 50
75	3,5-Dichlorobenzo- nitrile	65, subl			188				254 <sup>6</sup>			241	Me ester of acid, 58, n <sub>D</sub> <sup>26</sup> of amine 1 5690, HCl salt of amine, 300
76	cis-1,4-Dicyanocyclo- hexane	65			168 9								Acid + conc HCl at 180 → trans isomer, 300
77	Bromomalononitrile	65 6			113d	181	1	ļ			ļ		Di-p-toluidide of acid,
78	2-Naphthonitrile (2- Cyanonaphthalene)	66 62	305		184	192, 195						226	M p of amine, 60 N Acetyl deriv of amine, 126, Methiodide deriv
79	Cyanoacetic acid	66			135 6	170	226 7			120 w			of amine, 168, al Amide, 119 20, Anilide, 198 9, Warming with benzaldehyde → α- cyanocinnamic ac, 180 M p of amine, 200,
80	2-Cyano-2-ethylbutyric acid (Diethylcyano- acetic acid)	66 57	240 5, 164*		125, w	mono 146, di 224		100					HCl salt of amine, 123 NH <sub>3</sub> → Diethylcyano- acetamide, 121

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

		Melting	Boiling		Derivatives o	f the corres		icid		tives of th			
No	Name	point,	point,		Acıd			S-Benzyl	Amine	T_	Ben-		Miscellaneous
		°C	°C	ВP,	M P °C	Amide	Anilide	thiu- ronium chloride	BP, °C	Benz- amide	zene sulfon amide	Picrate	
81	2,4-Diphenylglutaro- nitrile	66, 70 I	220-75		2 forms (a) 164-5, w,(b) 185-6, chl- pet eth								Di-HCl salt of amine, 319 20, iso-PrOH
82	lpha-Chloro-3-tolunitrile	67, al	258 60		132, w	124						173	HCl salt of amine, 169, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 219
83	4-Chloro-2-tolunitrile	67		ļ	172	183			ļ				219
	1-Cyanoacenaphthene (Acenaphthene 1- carbonitrile)	68			161								
85	Phenylmalononitrile ( $\alpha$ - Cyanobenzyl cyanide)	69			152 3	233							
86	6-Nitro-2-tolunitrile	69 70	1,20	ĺ	184	163							Me ester of acid, 66
87	(4-Hydroxyphenyl) acetonitrile (4-Hy- droxybenzyl cyanide)	69 70, w	330		148-50	175						200	Acetate, 49 50 M p of amine, 160 l
88	5-Bromo-2-tolunitrile	70			187	180		l					
89	α-Bromo-2-tolunitrile (2-Cyanobenzyl bromide)	71 2	1244		147								Me ester of acid, 32 0-
90	2,2-Diphenylglutaro-	71 2 5			195-7,	1-mono							Anhydride of acid, 134,
91	nitrile (2-Aminophenyl)aceto- nitrile (2-Aminobenzyl cyanide)	72			183 119	142-4 93							Imide of acid, 158 9 N-Acetyl deriv, 120, Benzamide, 175-9, N-Acetyl deriv of acid
92	3,4-Dichlorobenzo- nitrile	72			208 9	133			139 40 <sup>17</sup>		   	228	Me ester of acid, 46 5 7 5, HCl salt of amine 240 2
93	1,2,2,3-Tetramethyl- cyclopentene-1-carbo- nitrile (Campholic nitrile)	73	217 9	255	106	80	91, al		210	98			240 2
94	Dicyanodimethyl amine (Bis(cyanomethyl) amine)	75,77			247 5, 225d	dı 143	dı 140 5		208	tri 166, ehl		<i>trı</i> 212d	N-Nitroso deriv, 43, N Benzoyl deriv, 131, 2, Tri-HCl salt of amine, 233
95	Diphenylacetonitrile (α-Phenylbenzyl cyanide)	75			148	168	180	145	1342	144-5		211 2 d	M p of amine, 42 3 5, HBr salt of amine, 205 7
96	4-Cyano-N,N-dimethyl- aniline	75 6	318		242 5- 3 5	206	182-3						Me ester of acid, 102, HCl salt of amine, 212
97	1-Cyanoisoquinoline	78, 93			161		1						
98	4-Cyanopyridine	78, 83			315	155-6			120 512			179- 80, al	HCl salt, 199, HAuCl <sub>4</sub> salt, 208 10
99	α-Chloro-4-tolunitrile (4-Cyanobenzyl chloride)	78-80, al	263		203	173						185	H₂PtCl <sub>8</sub> salt of amine, 226
100	2,5-Diphenylvaleronitrile	79			80-1,					]			
101	3-Cyanobenzaldehyde (3-Formylbenzo- nitrile)	79-81			lgr 175, w	190d							Oxime, 99-101, w , Sem carbazone of acid, 265 Phenylhydrazone of acid, 164

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

		Melting	Doubles	D		of the corres		cıd		ives of th			
No	Name	point,	Boiling point °C		Acid			S-Benzyl thru-	Amine	Benz-	Ben- zene		Miscellaneous
				ΒP, °C	МР, °С	Amide	Anilide	ronium chloride	ВР, *С	amide	sulfon- amide	Picrate	
102	6-Nitro-3-tolunitrile	80		<b></b> -	219	151							Me ester of acid, 81-2,
103	Benzoylacetonitrile	81			103-4d	113	108					155d	Et ester of acid, 55, al Carbazone of acid, 125, HCl salt of amine, 128
104 105	6-Chloro-2-tolunitrile 8-Cyanoquinoline	82 3 84, 50% al			102 187	167 171-3, w	}						Me ester of acid, 104 Et ester of acid, 38 b p 175-77
106	2-Nitro-3-tolunitrile	84			223	192							Me ester of acid, 74, me
107	2,3,4,5-Tetrachloro- benzonitrile	84			194 5	207 8, acet - al	197, al						M p of amine 90 l
108	4-Cyanobiphenyl	85 6			228	223			195 200 <sup>15</sup>				Me ester of acid, 117 8, Mp of amine, 128 HCl salt of amine, 308 10 282
109 110	2-Naphthylacetonitrile cis-2,3-Diphenylacrylo- nitrile	86, 81 86	228 30 <sup>23</sup>		142 137-8	200 167-8, chl - lgr	179, chl - pet eth						
111	4-Aminobenzonitrile (4- Cyanoanılıne)	86			188	182 9	Cui		268 70				N-Acetyl deriv, 205, N-Benzoyl deriv, 170 Picrate, 150
112	1-Cyano-2-phenylacrylo- nitrile (Benzalmalono- nitrile)	87		!	195-6d	dı 189-90							Di-Me ester of acid, 44 Di-Et ester of acid, 32
113	5-Bromo-2,4-dimethyl- benzonitrile	88 90	 		180-1	197 5- 8 5							
114	2-Cyanotriphenyl- methane	89	270- 85 <sup>20-30</sup>		162								Me ester of acid, 98, me
115	5-Cyanoquinoline	89 (anh), 70 (+15 H <sub>2</sub> O)			342	-							Picrate, 241, Styphnate, 241d, yel HCl salt 248, yel, Me ester of acid, b p 128-32° <sup>2</sup>
116	2,6-Dimethylbenzo- nitrile	90 1			116	138 5- 9 0, 120-5			96-8				Me ester of acid, b p 945
117 118	Phenylcyanoacetic acid 2-(N-Anilino)-propio- nitrile	92 92, al			162, w	144	127, al						Amide, 147, Anilide, 136 Et ester of acid, b p 272
	2,4-Dibromobenzonitrile β-(2-Nitrophenyl)- acrylonitrile	92 92, w	194- 6 <sup>7-8</sup>		174 cis 146-7, yel, trans 240	198 185							Me ester of acid, 33 Et ester of acid, 60
121	5-Chloro-2-nitro-4- tolunitrile	93			180-1								
122		93, al			155-6								
123	4-Nitro-3-tolunitrile	93-4			134	176-7							Me ester of acid, 78 9, me al
124	2-(N-Anilino)-isobutyro- nitrile	93-4, al			184-5, w	136	155, al						
125	2-Cyanoquinoline	94			157	133, 123	Ì		ŀ			1	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		Melting	Boiling	Г	Derivatives o	of the corre		acid		tives of the			
No	Name	point,	point,		Acıd			S-Benzyl thru-	Amine	Benz-	Ben- zene		Miscellaneous
				BP, ℃	МР, *С	Amide	Anilide	ronium	BP, °C	amide	sulfon- amide	Picrate	
126	4-Cyanovaleric acid (2-Methylglutaromono-nitrile)	95 6, w		205 812	79	dı 175 6							Di-p-toluidide of acid, 74 5, H <sub>2</sub> PtCl <sub>6</sub> salt of amine 202 3
127	1 '	96			295, 300	266	313-4	178, 182				ļ	
128 129	4-Chlorobenzonitrile 9-Phenanthrylaceto- nitrile	96,94 6 96 5-7 0	223, 955		240 224 5	179, 170 250-2	194		217	140		210	
130 131	3,5-Dibromobenzonitrile 2-Chloro-3-nitrobenzo- nitrile	97, subl 97-101, pa yel			219 20 185	187							Me ester of acid, 63 Me ester of acid, 70 Et ester of acid, b p 314d
132		98		21120	159	133	135						$D_{\alpha}^{996}$ 1 1052, $n_{\alpha}^{996}$ 1 53716 O-Benzoyl deriv, 106, pet eth, M p of amine, 125, 129, H <sub>2</sub> PtCl <sub>6</sub> salt of amine 197d HI salt of amine, 184
	4-Chloro-2-nitrobenzo- nitrile	98			142	172	104						Me ester of acid, 42-3
134	4-Cyanotriphenyl- methane	100, me al			165, ac a		196, ac a						
135	4-Chloro-3-nitrobenzo- nitrile	100 1			181-2	156	131				İ	210d	Me ester of acid, 83 HCl salt of amine, 227 8
136 137	, , ,	101 101 2,			164 5 120-1	153 225							Amide, 130, Di-Me
138	propionic acid 3-Cyanophenanthrene	75 102			269	233 4, 227-8	216 7						ester of acid, 35 6
139	2,3 <sub>e</sub> 3-Triphenylpropio- nitrile	102, me al			222-3, al	213					1.0		Me ester of acid, 162, HCl salt of amine, 269
140	4-Cyanoquinoline	102			253 4	181							Methiodide, 216, HAuCl, salt, 232 Di- HCl salt of amine, 255d
141	4-Bromo-1-naphtho- nitrile (1-Bromo-4- cyanonaphthalene)	102-3			212, 220								Me ester of acid, 42
142	4-Bromo-2,5-dimethyl- benzonitrile	103-4			171 5- 2 5	209-10							
	5-Nitro-3-tolunitrile 2,4-Dinitrobenzonitrile	104 5 104 5, al			174 182–3	164-5 203-4							Me ester of acid, 84-5 Me ester of acid, 70, Hydrazide of acid, 231-3
145 146	4-Nitro-2-tolunitrile 6-Chloro-3-nitrobenzo- nitrile	105 105-6			179 165	173 4 178							Me ester of acid, 69 Me ester of acid, 73.
147	i	106-7	į		226	235	,						
148	2-Nitro-4-tolunitrile	107, pa yel			190	166							
149	9-Cyanophenanthrene	107, 111 0- 3			256 5- 7 0	232-3, 226	218			167		241	M p of amine, 108 5 HCl salt of amine, 294, N-Acetyl deriv of amine, 182 3
150	3-Cyanoquinoline	108			275	198-9, 195							Picrate of acid, 217-8

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

		Malara	n.d.	C	Derivatives o	of the corres		ecid		tives of th			
No	Name	Melting point °C	Boiling	,	<b>A</b> cid			S Benzyl thru	Amine	D	Ben		Miscellaneous
		_	°C	BP, °C	M P °C	Amide	Anilide	ronium	<b>В</b> Р, °C	Benz- amide	zene sulfon- amide	Picrate	_
151 152	2-Cyanophenanthrene 3-Nitro-2-tolunitrile	109 109 10			259 60 151 2 pa yel	242 3 158	217 8						Me ester of acid, 50
153	2-Nitrobenzonitrile	110			146	174 6	155						HCl salt of amine, 248
154	4-Chloro-1-naphtho- nitrile (1-Chloro-4- cyanonaphthalene)	110			223-4, 210	235 6							30
155	5-Cyanoacenaphthene (Acenaphthene-5- carbonitrile)	110 1			219, bz	198				182-4	148-9		
156	4-Bromobenzonitrile	112	235 7		251	189 90			250	143		221	M p of amine, 20 N- Acetyl deriv of amine 113
157	2,4,5-Trimethoxybenzo- nitrile	112 4. al		<i>ca</i> 300	144, bz - pet eth	184 5	154 5						Me ester of acid, 97 5 Et ester of acid, 72
158	4-Hydroxybenzonitrile (4-Cyanophenol)	113			213-4	162 (+1 H <sub>2</sub> O)	196 7						M p of amine, 109 (anh), 95 (+1H <sub>2</sub> O) HCl salt of amine 195 HI salt of amine 198 200
159	<b>2,3-Diphenylvaleronitrile</b> (2 forms)	(a) 115 al	(a) 235 40 <sup>20</sup> (b) 210 2 <sup>20</sup>		(a) 152- 3 (b) 178 lgr								
160	α- <b>Bromo-4-tolunitrile</b> (4-Cyanobenzyl bromide)	115 6 al			229 30								Me ester of acid, 54 Et ester of acid, 35 6
161	· ·	116			153	197 8 191	198						
162	6-Bromo-3-nitrobenzo- nitrile	117			180	197 8	166						
163	(2-Hydroxyphenyl) acetonitrile (2-Hy- droxybenzyl cyanide)	117 9		240 3	147 9	116 8, al		163					O-Benzoyl deriv 50, lgr HCl salt of amine, 155
164 165	3-Nitrobenzonitrile	118 120			140 203 4	141-3 156	153 4						HCl salt of amine 224
166	4-Cyanoazobenzene	120 I, br,bz			241, red, al	224-5, red							Me ester of acid, 123 4, or, me al, Et ester of acid, 86-7, red, al
167	Dipicolinonitrile (2,6- Dicyanopyridine)	123 113	l i		252d 228	dı 302							Di-Me ester of acid, 124 5 Di-Et ester of acid, 41 2
168 169	2-Cyanohexanoic acid Dibromomalononitrile (Bromodicyano- methane)	123-6 5 124			101 147d 136- 7d	di 200 di 200, 206d	dı 193						D <sub>1</sub> -Me ester, 67
170	· ·	126			245, yel, al.	260							Me ester of acid, 108, yel, ac a
171	2,2,3-Triphenylpropio- nitrile	126			162 132	111, al							Me ester of acid, 127
172	1-Cyanophenanthrene	128			232-3	284	245						

 $<sup>\</sup>begin{tabular}{ll} \be$ 

		Maltina	Barlina		erivatives o RC	f the corres		ıcıd		tives of th			
No	Name	Melting point,	Boiling point,		Acıd			S Benzyl thiu-	Amine	Benz-	Ben- zene		Miscellaneous
		•c	°C	B P , °C	M P °C	Amide	Anilide	ronium chloride	BP,	amide	sulfon- amide	Picrate	
173	2,3-Diphenylbutyro- nitrile (2 forms)	(a) 129- 30	210 216		133-4	173 4						,	
	,		(b) 188 92 <sup>13</sup>		186	193							Et ester of acid, 91 2
174	5-Bromo-3-nitro-4- tolunitrile	130	/-		206	171							
175	2,5-Dichlorobenzonitrile	130	ļ	301	154	155		ļ	1359			230	HCl salt of amine, 151 2
176	2,5-Dibromobenzonitrile	132			157			- Annual - A					Me ester of acid 40 1, p-Nitrophenyl ester of acid, 183 4
177	5-Bromo-2-nitro-4- tolunitrile	132			203 200	191		1					Et ester of acid, 61
178	2-Hydroxy-3-nitro- benzonitrile (2 Cyano- 6-nitrophenol)	132 3			148	155 145 6							Me ester of acid, 132 (94) al
179	4-Nitro-1-naphthonitrile (1-Cyano-4-nitro naphthalene)	133			220 1	218							Me ester of acid 107-8
180	4-Acetamidobenzo- nitrile	133, w			185, ac	177, al	167 8, al						N-Methylamide of acid, 172, al
181	6-Cyanoquinoline	135, bz - lgr			291 2	174, bz - al	1		158-92				Me ester of acid, 90 HCl salt of amine, 239, n <sup>20</sup> of amine 1 6390
182	Apiolonitrile (2,5-Di- methoxy-3,4-methyl enedioxybenzonitrile)	135 5, al			175, w	}							Me ester of acid, 71 2, al
183	1-Nitro-2-naphthonitrile (2-Cyano-1-nitro- naphthalene)	138			239								Hot aq Ba(OH) <sub>2</sub> → 1- hydroxy-2 naphthoic acid, 191 2 al
184	3,5-Dichloro-2-hydroxy benzonitrile	139			219 5	209							Me ester of acid 147
185	trans-1,4-Dicyanocyclo- hexane	140			300								Di-Me ester of acid, 71
186	3,3,3-Triphenylpro- pionitrile	140, al			177	198							Me ester of acid, 120-1 5
187	4-Cyano-2-phenyl- quinoline (2-Phenyl-4- quinolinonitrile)	140, al	ca 365		218	196	198						M p of amine > 287 HCl salt of amine 232 5
188	Phthalonitrile (o-Di- cyanobenzene)	141			200 6	di 219	di 253	di 151,	.}	dı 184	.	170	N,N -Diacetyl deriv of diamine, 146
189	8-Nitro-2-naphthonitrile (2-Cyano-8-nitro-	143			295, 288	218				!			Et ester of acid, 121 lgr
190	naphthalene) 5-Chloro-2-naphtho- nitrile (5-Chloro-2-	144			270	186-7	202						Me ester of acid 81 Et ester of acid 45
191	cyanonaphthalene) 5-Chloro-1-naphtho- nitrile (5-Chloro-1-	145			245, 241 2	239							Et ester of acid, 42
192	cyanonaphthalene) 3,5-Dichloro-4-hydroxy-	146			269, 265								Acetate, 93 Me ester of
193	benzonitrile 4-Nitrobenzonitrile	147,			241	200	211,					184 5	acid, 122 HCl salt of amine,
194	5-Bromo-1-naphtho- nitrile (1-Bromo-5- cyanonaphthalene)	149 147			261, 256	241	204						235-40 Et ester of acid, 48 9

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

_				Ε	Derivatives o	of the corre		acıd		ives of th				
No	Name	Melting point	Boiling point		Acıd			S-Benzyl	Amine	_	Ben		Miscellaneous	
		·c	•c	B₽.	M P	Amide	Anilide	thiu- ronium chloride	<b>ВР</b> 'С	Benz- amide	zene sulfon- amide	Picrate		
195	5-Iodo-2-naphthonitrile (2-Cyano 5 iodo- naphthalene)	148 5			264, al	196	203						M p of amine, 120 HCl salt of amine, 251 3 N-Acetyl deriv amine 135-6	
196	3-Cyano-3-phenylpro- pionic acid	150	215 810		166-7								Di-Me ester of acid, 55, al, Imide of acid, 88- 90, Mp of amine, 209 HCl salt of amine, 203, N-Acetyl deriv of amine, 65	
197	2-Cyano-2-propylvaler- amide (Dipropyl- cyanoacetamide)	153			161	di 214	di 168 8 5, me al			<u>.</u>				
198	2,6-Dibromobenzonitrile	155, subl	308 9		157	208 5					 		Me ester of acid, 83 Hydrazide of acid, 204	
199	3-Chłoro-4-hydroxy- benzonitrile	155			169-70, w, 164 5	180-2							Me ester of acid, 106 7, Et ester of acid, 77-8	
200	5-Chloro-2,4-dinitro- benzonitrile	156			182 3	212	226							
201	4-Benzamidobenzonitrile (N-Benzoylanthra- nilonitrile)	156	]		181	218 9	279						Me ester of acid, 100 Et ester of acid 98	
202	5-Bromo-2-hydroxy- benzonitrile	158-9			165	232	222						O-Acetyl deriv of acid,	
203	d l-2,3-Diphenyl- succinonitrile	160			183 (+ 1 H <sub>2</sub> O)		mono 173 5, al							
204	Isophthalonitrile (m-Dicyanobenzene)	161 5 2 0	ĺ		345 7	di 280								
205	2-Hydroxy-4-nitrobenzo- nitrile (2-Cyano-5- nitrophenol)				235, 226, w	192 4							Benzoate, 122, yel, al, Et ester of acid, 84-5	
206	d l-4-Cyano-3,4-di- phenylbutyric acid (d l-2,3-Diphenyl- glutaromononitrile)	162 3, bz			208-10 (cor), aq ac a	mono 200-5 d, al	mono 201- 2, 50% al						Et ester, 99-100, al, Imide of acid, 225-9, aq al	
207	d-3-Carboxy-2,2,3-tri- methylcyclopentyl- acetonitrile	164				233, PhNO₂							$[\alpha]_D$ +64 41, Me ester, 77, Et ester, 58	
208	5-Chloro-2-hydroxy- benzonitrile (4-Chloro- 2-cyanophenol)	165-7			172, 167 5	226							Me ester of acid, 84	
209	2,3-Diphenylcinnamo- nitrile (Cyanotri- phenylethylene)	166 7, 162-3			213	223								
	1,7-Dicyanonaphthalene 4,4'-Dicyanodiphenyl- methane	167, al 169			294-6 334, 290								D <sub>1</sub> -Me ester of acid, 81 2	
212	2,2'-Diphenic acid mono- nitrile (2-Carboxy-2'- cyanobiphenyl)	170 2, bz			233 5	mono 193, di 212	mono 181-3						Di-Me ester of acid, 74, Me ester, 110, Et ester, 91-2	
213	5-Nitro-2-naphthonitrile (2-Cyano-5-nitro- naphthalene)	172-3			295, yel	261-3, br -yel							Me ester of acid, 112, yel	

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

	Name	Melting	Boiling		Derivatives o	f the corres		ıcıd		tives of the			
No		point *C	point		Acid			S-Benzvl thru	Amine	Ben/	Ben zene		Miscellaneous
				B P	M P	Amide	Anilide	ronium	B P *(	amide	sulfon amide	Picrate	
214	9-Cyanoanthracene (9- Anthracenecarbo- nitrile)	175, 170-2			207, pa yel								Me ester of acid, 111, M p of amine, 90
215	2,3-Dicyanopyridine	175 6			228 9	2-mono 168 5 d, di 165							
216	1,3-Dicyanonaphthalene	179,			267 8					1		<u> </u>	
217	3-Cyanocoumarin	ac a 182			187 d	236	250			İ		[ ]	Me ester of acid, 116 7 Et ester of acid, 64
	2-Cyanocinnamic acid	183, al			195 6d	di 189- 90							NH <sub>3</sub> → 2-Cyanocinnam- amide, 123 Me ester of nitrile 89 Di-Me ester of acid, 44 5
219	2-Cyanobenzoic acid	187, 192			200 6	di 219	di 253	di 151, 157		di 184		170	NH <sub>3</sub> → 2-Cyanobenz- amide, 173 Me ester 51 Et ester, 70 65
220 221	nitrile (2-Cyano-4-	190, bz 194-6, yel , w			175 229-30, 227	di 265 225, al							p-Nitrobenzoyl ester of acid, 115
222	nitrophenol) Tetracyanoethylene	198 200, subl	223										n½ 1 560 D² 1 348 N.N Dimethylaniline → N,N-dimethyl 4-tri cyanovinylaniline 173 5, ac a Anthra cene → adduct, 268 70 acet
223	5-Nitro-1-naphthonitrile (1-Cyano-5-nitro- naphthalene)	205			241 2, 239	235 6							Me ester of acid, 109- 10, Et ester of acid, 93
224		208, ac a	ļ		309, 288	ļ							Di-Me ester of acid, 67 Di-Et ester of acid, 64
225 226	1,6-Dicyanonaphthalene 1,5-Dicyanonaphthalene	208-10 211, 266-7			310 310, ac a								Di-Me ester of acid, 99 Di-Me ester of acid, 114 5 Di-Et ester of acid, 123~4
227	3-Cyanobenzoic acid	217			345	280							NH <sub>3</sub> → 3-Cyanobenz- amide, >300 Me ester.
228	4-Cyanobenzoic acid	219			ca 300, subl	di > 250	dı 334-7					232 d	65, Et ester, 56 NH <sub>3</sub> → 4-Cyanobenz- amide, 223, Me ester, 62, Et ester, 54
229	Terephthalonitrile (p-	222			ca 300,	di >250					ĺ	232 d	N,N'-Diacetyl deriv of
230	Dicyanobenzene) 1,8-Dicyanonaphthalene	232			subl 260	<i>di</i> 250 82d	334-7						diamine, 225 Di-Me ester of acid, 102 3, Di-Et ester of acid, 58 60
231	4,4'-Dicyanobiphenyl	233 4											Di-Me ester of acid, 214 224, Di-Et ester of acid, 112, Heating acid with lime
232	/-2,3-Diphenylsuccino- nitrile	239 40			176-7, 190, w								Imide of acid, 196 8, ac a

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

	Name	Melting	Boiling : point *C	C	erivatives o RC	f the corres N • RCO		cıd		ives of the				
No		point °C		,	Acid			S Benzyl thiu	Amine	Benz	Ben	[	Miscellaneous	
				B P °C	M P °C	Amide	Anilide	ronium chloride	B P °C	amide	zene sulfon amide	Picrate		
233	1-Cyano-9,10-anthra- quinone	247, yel, ac a			293 4, pa yel, ac a	280, pa yel, al	288-9, pa yel, PhNO <sub>2</sub>						Me ester of acid, 189, yel, Et ester of acid, 169, yel	
		251, al 267 8, ac a			239-41 >320	dı 297-8							Imide of diacid, 275 Di-Me ester of acid	
236	2,6-Dicyanonaphthalene	293, al			>300 d	dt > 320							Di-Me ester of acid, 19	

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides. Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives

Sulfonyl chloride

From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent For directions and examples see Cheronis, p. 638, Linstead, p. 89, Shriner, pp. 268, 270, Vogel, p. 553, Wild, p. 161

Sulfonamide \*

$$\begin{array}{cccc} RSO_3Na & \rightarrow & RSO_2Cl & \xrightarrow{NH_3} & RSO_2NH_2 \\ & & & & Sulfonyl & Sulfon \\ & & & chloride & & amide \end{array}$$

From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution For directions and examples see Linstead, p. 49, Shriner, pp. 268, 270 Vogel, p. 553, Wild, p. 161 From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

See Cheronis, p. 639

Sulfonanilide \*

From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide For directions and examples see Linstead, p. 89, Wild, p. 161
From the sulfonyl chloride and aniline
See Vogel, p. 553

Sulfon-p-toluidide \*

$$RSO_3Na \rightarrow RSO_2Cl \xrightarrow{p-CH_3C_6H_4NH_2} RSO_2NHC_6H_4CH_3-p + NaCl$$
Sulfonyl Sulfon p-toluidide chloride

From the sulfonyl chloride, p-toluidine and aqueous sodium hydroxide For directions and examples see Vogel, p 553

Sulfon-I-naphthylamide \*

From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene For directions and examples see Cheronis, p. 639

S-Benzylthiuronium salt \*

$$RSO_3Na + [C_6H_5CH_2SC(NH_2)_2]^+Cl^- \rightarrow [C_6H_5CH_2SC(NH_2)_2]^+RSO_3^- + NaCl \\ S-Benzylthiuronium chloride S-Benzylthiuronium sulfonate$$

From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

For directions and examples see Cheronis, pp. 635, 636, Linstead, pp. 15, 89 Shriner, p. 269, Wild, pp. 149, 159, E. Chambers and G. W. Watt, J. Org. Chem., 6, 376 (1941), E. Campaigne and C. M. Suter, J. Amer. Chem. Soc., 64, 3040 (1942), S. Veibel, J. Amer. Chem. Soc., 67, 1867 (1945)

#### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### EXPLANATIONS AND REFERENCES TO TABLE XXII AND XXIII (Continued)

From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol See J J Donleavy, J Amer Chem Soc, 58, 1004 (1936)

Anılınıum salt \*

$$RSO_3Na + C_6H_5NH_2 + HCI \rightarrow [C_6H_5NH_3]^+RSO_3^- + NaCI$$
Anilinium sulfonate

From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water

For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)

p-Toluidinium salt \*

RSO<sub>3</sub>Na + 
$$p$$
-CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>NH<sub>2</sub> + HCl  $\rightarrow$  [ $p$ -CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>NH<sub>3</sub>]<sup>+</sup>RSO<sub>3</sub><sup>-</sup> + NaCl  $p$  Toluidinium sulfonate

From the sulfonic acid and p-toluidine

For directions and examples see Shriner, p 269

From the sodium, potassium or ammonium salt with p-toluidine or p-toluidine hydrochloride in water See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942), A D Barton and L Young, J Amer Chem Soc, 65, 294 (1943)

From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with p-toluidine and hydrochloric acid

See Cheronis, p 637, Fieser, J Amer Chem Soc, 51, 2460 (1929)

o-Toluidinium salt \*

$$RSO_3Na + o\text{-}CH_3C_6H_4NH_2 + HCI \rightarrow [o\text{-}CH_3C_6H_4NH_3]^+RSO_3^- + NaCI$$

$$o\text{-}Toluidinium sulfonate}$$

From the sodium or the potassium salt of the sulfonic acid with o-toluidine and hydrochloric acid in water For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)

Phenylhydrazınıum salt \*

From the sulfonic acid with phenylhydrazine in water-alcohol

For directions and examples see Wild, p 159, P H Latimer and R W Bost, J Amer Chem Soc, 59, 2500 (1937)

Phenols by KOH fusion

$$ArSO_3Na + NaOH \rightarrow ArOH + Na_2SO_3$$
Phenol

By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible For directions and examples see Vogel, p 552

By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust See Linstead, p 89

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

No	Name	Melting point °C	S-Benzyl thiuro nium salt	p-Tolui- dinium salt	Anı- lınıum salt	o Tolui- dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon- anilide	Sulfon- I-naph- thylamide	Miscellaneous
1	Propane-1-sulfonic acid			67-8			bp 180	52, eth		84	Phenylhydrazine
2	Ethane sulfonic acid		115				bp 171	60, eth		66	salt, 204 5 Phenylhydrazine salt, 182 8
3	Propane-2-sulfonic acid	- 37					bp 791*	60, eth - pet eth		134	B p 1591 4, $D_4^{15}$ = 1 1877, $n_D^{10}$ = 1 4332, m-T uidide, 109
4	Heptane-1-sulfonic acid						16	75			Phenylhydrazine salt, 100 0 5
5	2,4,5-Trimethoxybenzene sulfonic acid						130	76	170		
6	Methane sulfonic acid	20					bр 60²¹	90	100	125-6	Phenylhydrazine salt, 193 5-4d
7	Hexadecane-1-sulfonic acid (Cetyl sulfonic acid)	54					54	97			
8 9	10-Bromocamphor-3-sulfonic acid Benzyl sulfonic acid			113, al	102	83	97 92 3, eth, bz	100 2 105, w , al	102, al	166 (146), yel, al	Diethylamide, 29, Ethylamide, 65-6, Hydrazide, 131-2, Methylamide, 109- 10, Phenylhydra- zine salt, 173
10	3-Toluene sulfonic acid (3- Methylbenzene sulfonic acid)	oil		106		108	12	108, al	96, al		,
11	3-Hydroxynaphthalene-2-sulfonic acid				241 2		112	110			
12	Pyridine-3-sulfonic acid	357					Hydro- chloride, 141-4 d	110 1	145		Diethylamide, 49– 50, Hydrazide, 94, me al
13	2,6-Dimethylbenzene sulfonic acid	98					39	113 (96)			
14	2-(N-Methylamino)benzene sulfonic acid	182 d						114 5 5 5			N-4-Toluene sulfonyl, 193
1	Indane-4-sulfonic acid			i		ĺ	53 3 5	118~9, w		ļ,	
	2-Phenylethane-1-sulfonic acid 4-Formylbenzene sulfonic acid (Benzaldehyde-4-sulfonic acid)	91					33	122	77		Amide oxime, 185, Dimethylamide, 134-7, Di-O-ace- tate, 86-7 5, Chlo- ride diacetate,
18	2-Methylnaphthalene-1-sulfonic acid			1			83-5	124			111-3
19	4-Fluorobenzene sulfonic acid					ļ	36 (30)	125 (123),		i	
20	4-Chloro-3-methylbenzene suffonic acid						65	w   128	92		Sulfonyl bromide, 67 5
21	3-Chloro-4-methoxybenzene sulfonic acid						82	131			
	3-Ethoxybenzene sulfonic acid						38	131			!
	D-Camphor-10-sulfonic acid 2-Fluoronaphthalene-6-sulfonic	193 105					67 97, chl	132 133	121 129		
- 1	acid DL-Camphor-8-sulfonic acid 3-Methyl-4-nitrobenzene sulfonic acid	56 8					106 50	133-5, w 133 5	1		• •
27	3-Chloro-4-methylbenzene sulfonic acid						38	134	96		
28	3,5-Dimethylbenzene sulfonic acid			121-2, al			94 (90), bz	135, al	119, ai		

<sup>\*</sup>Derivative data given in order im pi, crystal color, solvent from which crystallized

Νo	Name	Melting point °C	S-Benzyl thiuro nium salt	p Tolui dinium salt	Anı lınıum salt	o Tolui- dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon anilide	Sulfon I-naph thylamide	Miscellaneous
29	Indane-5-sulfonic acid	92					46-7, eth	135 5 6,	129, al		
30	D-Camphor-8-sulfonic acid						138, ([α] <sup>14</sup> +128 7 in chl )	al 137, ([ $\alpha$ ] $_{0}^{13}$ +93 6 in al )			
31	4-Toluene sulfonic acid (4- Methylbenzene sulfonic acid)	104 5 (92)	181-2	198	238	190	71, eth	anh 138 5 9, dihyd 105	103, eth -al	157, al	Phenylhydrazide, 155, al, o-Tolui- dide, 110, aq ac a, Triethylam-
32	2,4-Dimethylbenzene sulfonic acid	62 (hvd)	146	ļ			34	139 (137)	110		monium salt, 65
33	4-Vinylbenzene sulfonic acid (4-Styrene sulfonic acid)	(//////		182 3				139 40		İ	Dimethylamide, 62 3
- 1	3,4-Dichlorobenzene sulfonic acid 2-Bromonaphthalene-1-sulfonic acid						22 4 (19) 97	140 (135) 140			
36	2,4,6-Trimethylbenzene sulfonic	77					56	142	109		
37	3-Aminobenzene sulfonic acid (Metanilic acid)		148					142			
38	D-Camphor-2-sulfonic acid			196 7			88	143	124		Me ester 77, $([\alpha]_D$ +98 6 in chl)
39	4-Methylnaphthalene-2-sulfonic acid						124-5, eth	143 4, al			+ 70 0 111 €111 )
40	3,4-Dimethylbenzene sulfonic acid	64	208				52	144	ŀ		
t	4-Chiorobenzene sulfonic acid	93	175	208 10	222 3	163 4	53	144	104	190	
42	4-Methyl-3-nitrobenzene sulfonic acıd	92 hyg		130	109	128	36	144 5		153	
43	3-Bromocamphor-8-sulfonic acid	195 6 (anh)					136 7	145			
44	5-Chloro-2-methylbenzene sulfonic acıd	(,					24 (21)	145, aq al			
45	4-Bromo-3-methylbenzene sulfonic acid						50	146			
46	4-Methoxy-3-nitrobenzene sulfonic acid						66	146 3			
47	3-Chlorobenzene sulfonic acid			199 200	206 7			148			
	2,5-Dimethylbenzene sulfonic acid		184				24 6	148			
- 1	Naphthalene-1-sulfonic acid	90	137	181	183	237	68 (66)	150	112 (152)		
1	4-Ethoxybenzene sulfonic acid 4,6-Dichloro-2,5-dimethylbenzene sulfonic acid						39 81	150 150	175		
52	3-Bromo-4-methylbenzene sulfonic						60	151			
53	Benzene sulfonic acıd	66	148	205	240	176	14 5	153 (156)	112	170 1	N-Xanthylsulfon- amide, 200
54	2-Aminobenzene sulfonic acid (Orthanilic acid)		132					153	(170)		N-Benzoyl deriv of amide, 198, Hydro- chloride, 201
55	2-lodonaphthalene-1-sulfonic acid						110	154			emoriae, zor
56	2,6-Dichloro-4-methylbenzene sulfonic acid						56	154-5			
57	2-Chloro-5-methylbenzene sulfonic acid						56	156	229 30 5		
58	sulfonic acid 2-Toluene sulfonic acid (2- Methylbenzene sulfonic acid)	57	170	203 4	218		10	156 3	30 5 136, aq al		Sulfonyl bromide, b p 13810, N- Xanthylsulfon-

<sup>\*</sup>Derivative data given in order im p | crystal color, solvent from which crystallized

No	Name	Melting point, °C	S Benzyl thiuro- nium salt	p-Tolui dinium salt	Anı lınıum salt	o-Tolui dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon anihde	Sulfon I naph- thylamide	Miscellaneous
59 60	l	47 5 106 8 (hvd)					65 102	156 5 157 (154)			Hydrazide, 110
61	2-Methyl-4-nitrobenzene sulfonic acid	130 (anh)				177	106	157			
62	Benzophenone-3,3'-disulfonic acid	(ann)					di 137 8	di 157	dı 177 8		Methylamide, 106 7, Dimethylamide, 118 9
63 64	1	74					100, bz di 89 91	159, w di 160 1			110 7
65	2-Nitrodiphenylamine-4-sulfonic	220 d					157	162			
66	acid 2-Ethoxybenzene sulfonic acid						65 6	163	158		Phenylhydrazide,
67	3-Methyl-2-nitrobenzene sulfonic		ļ				58 5	163 5			132 3
68	acid 3-Amino-6-methylbenzene sulfonic acid							164	146 7		Chloride of N-acetyl deriv, 124 Chlo- ride of N-chloro- acetyl deriv, 87, Amide of N-acetyl
69	4-Chloro-2-nitrobenzene sulfonic acid						75	164	138		deriv , 242 Anhydride, 114-5, Phenylhydrazide,
70	4-Aminobenzene sulfonic acid		185	109		132		165	200	196	151, Ph ester, 82 N-Acetyl, 214,
71	, , , ,						71	165	171		Me ester, 92
72	sulfonic acid 6-Aminonaphthalene-1-sulfonic		172 4					165			Benzoylguanidine
73	acid 4-Bromobenzene sulfonic acid	102 3	170	215 6	237 8	182 3	76, eth	166 (161)	119	183 4	salt, 210-11
74	· · · · · · <b>,</b> · · ·	(88 9)					33 5	167			
	sulfonic acid  2,3-Dimethylbenzene sulfonic acid						47	167			
76	sulfonic acid						60	167			
	3-Nitrobenzene sulfonic acid	48	146	222	222	193	64	167	126	166 7	
79	4,6-Dichloro-2-methylbenzene sulfonic acid						43	168			
1	4-Chloronaphthalene-2-sulfonic acid						106	168			Et ester, 76 9
Ì	4-Bromo-2-methylbenzene sulfonic acid						50	168			
82	Propane-1,3-disulfonic acid	92, d with- out melt-					di 45	<i>di</i> 169, w	di 129		B p 15714, Di-m- toluidide, 222, Di- hydrazide, 105
83	Propane-1,1-disulfonic acid	ıng	ļ					di 169 70	151 2,		Di-(N-ethyl)ani-
84	3-Carboxybenzene sulfonic acid	98	163		224 6		dı 20	di 170	al		lide, 128 9, al
85	(3-Sulfobenzoic acid) 4-Methyl-2-nitrobenzene	(hvd ) 141					98 9	170			o-Anisidide, 135
86	sulfonic acid 2,4-Dimethyl-3-nitrobenzene sulfonic acid	(anh ) 144 (anh )	ļ				96	172			

<sup>\*</sup>Derivative data given in order im pi, crystal color, solvent from which crystallized

No	Name	Melting point, °C	S-Benzyl thiuro nium salt	p Tolui dinium salt	Anı lınıum salt	o-Tolui dinium salt	Sulfonyl chloride	Sulfon amide	Sulfon- anilide	Sulfon- 1-naph- thylamide	Miscellaneous
87	2,5-Dimethyl-3-nitrobenzene	128		135-6		126 5-	60 1	172 3	143 4		
88	sulfonic acid 4-Nitrodiphenylamine-2-sulfonic acid					7 5	102-4	173	164		
90	3,4-Dibromobenzene sulfonic acid	66 5 7 5 (anh)					34	175			
91	4-Chloro-3-nitrobenzene sulfonic	( /					40 1	175-6, yel, al			
92	3-Amino-4-methylbenzene sulfonic acid							176			N-Acetyl of chlo- ride, 144, N- Benzoyl of Chlo- ride, 196, N-
93	7-Chloronaphthalene-2-sulfonic acid	118 (anh), 68 (tetra-					86 5	176			Benzoyl, 203 Me ester, 89, Et ester, 65
94	4-Bromo-3-nitrobenzene sulfonic	hyd)					55 7	176 7			
95 96	4-Hydroxybenzene sulfonic acid 5-Methylnaphthalene-1-sulfonic acid	115	169	202	170	192		176-7 176-8	141		
97	4-Methylnaphthalene-1-sulfonic						81	177	158		
98	4-Nitrobenzene sulfonic acid	95 (109 11),		179 80			80, lgr	180, 50% al	136 (171), al		
99	3-Chloro-2-methylbenzene sulfonic acid	hyg 60 72, 72 (anh)					72, pet eth	180, w	ai		
100	2,5-Dichlorobenzene sulfonic acid	93 7 (>100)	170	247-8	262 3	250-1	38	181 (186)	160	160	
101	2,4,5-Trimethylbenzene sulfonic acid	112					61 2	181			
102								181	146 7		N-Acetyl deriv of amide, 213, Benzoylguanidine salt, 214-6
103	5-Chloro-4-methyl-2-nitrobenzene sulfonic acid	128	1				99	181			5411, 211
104 105	2,4-Dichlorobenzene sulfonic acid 4-Iodobenzene sulfonic acid	86		204-6		170-2	55 85	182 183	143		
106	Quinoline-8-sulfonic acid	312					124	183 4			Picrate of Na salt, 226 7, Me ester,
107	6-Chloronaphthalene-2-sulfonic acid		;				110 5	183-4			96, Et ester, 73 Me ester, 89, Et ester, 79, Sulfonyl bromide, 124
108	5-Nitronaphthalene-2-sulfonic	118-9,			260		125	184, yel			5.01(1 <b>00</b> ) 127
109	4-Chloro-2-methylbenzene	yel					54	185			
110	sulfonic acid 4-Chloro-2,5-dimethylbenzene sulfonic acid	100					50	185	155	:	

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

No	Name	Melting point, °C	S-Benzyl thruro- nrum salt	p Tolui dinium salt	Anı- lınıum salt	o Tolui- dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon- anilide	Sulfon- I-naph- thylamide	Miscellaneous
111	2-Carboxy-5-methylbenzene sulfonic acid	190 (158), (anh)					di 59	185			Nitrile of the sul- fonyl chloride, 67, lgr, NH <sub>4</sub> salt of 2- amide, 186 (mono- hyd)
112	8-Chloronaphthalene-2-sulfonic acid						94	185-6		i I	Et ester, 92
113	2-Chloro-5-nitrobenzene sulfonic acid	168-9 d (hyd)					89-90, w	185 6, w			
114 115							51, eth 49	186, w 186			
116		133 5 (di-		256 7		256-8	46 7	186	148		
117	2-Chloro-4-methylbenzene sulfonic acid	hyd)					46 (52)	186			
118	3,5-Dichloro-2-methylbenzene sulfonic acid			! !			54	186	ļ		
119	6-Chloro-3-nitrobenzene sulfonic acid	168 9					90, eth	186, w	}		
120	2,4-Dimethyl-5-nitrobenzene sulfonic acid	132 (122), dıl HNO <sub>3</sub>					98	187 (179)			Sulfonyl fluoride, 109-10
121	2-Methyl-5-nitrobenzene sulfonic acid	131					46 7 (44), eth -pet eth	187	148		
122	4-Chloronaphthalene-1-sulfonic acid	130 3 d			145-6	151	95	187	145-6	162	Me ester, 83, Et ester, 104
123 124	8-Iodonaphthalene-I-sulfonic acid 2,4-Diaminobenzene-1,5-disulfonic acid						115 275	187 187	140 236		
125	2,6-Dichloro-3-methylbenzene sulfonic acid						19 5	188	ı		
	4-Nitronaphthalene-1-sulfonic acid						99	188			
127	2-Chlorobenzene sulfonic acid 5-Methylnaphthalene-2-sulfonic acid						28 5, eth 120-2	188 188 9	248-50		
129	Phenanthrene-3-sulfonic acid	175 6 (anh), 120-1 (mono-hyd), 88-9 (di-		222			110-1 (108)	190			Me ester, 119-20, al, Et ester, 107 8
130	2,4-Dibromobenzene sulfonic acid	hyd) 110 (anh)					79, eth	190			
131	8-Nitronaphthalene-1-sulfonic acid	(tri- hyd)		: !			165 d	190 5-1 5	178-8 5		
1	4-Methylbenzene-2,4-disulfonic acid 3,5-Dichloro-4-methylbenzene	oil		277 d	dı 189	170-1	54 (56), eth 69	di 190 5-1	189		
1	sulfonic acid	145		158 5-9,	:	143-5,	110, eth -	192, 50%	182, bl ,		
1,54	sulfonic acid	(anh)		al		50% al	pet -eth	al	al		

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, °C	S-Benzyl thiuro- nium salt	p-Tolui dinium salt	Anı lınıum salt	o Tolui- dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon- anilide	Sulfon- 1 naph- thylamide	Miscellaneous
	Quinoline-6-sulfonic acid 3,4-Dicarboxybenzene sulfonic acid (4-sulfophthalic acid)	> 260 138-40 (mono- hyd)					91 167-70 d , eth	192 192- 200 d , w			
137 138		70 (85) 174 (anh) 134		235			69 127	193 193 4, al	115		Me ester, 106, me al, Et ester, 108, al
139	2-Carboxybenzene sulfonic acid (2-Sulfobenzoic acid)	(hyd) 68 9 (hyd), 134 (anh)	206	197 (200)	165	127-8	79, pet eth , 40, eth	C 193-4 (anh), S 153 4, sl htng	194 5		
140	4-Bromonaphthalene-1-sulfonic acid	(unn )					87	195			
	2,5-Dibromobenzene sulfonic acid	128 (anh)					71, pet eth -eth	195, al			
	7-Methylnaphthalene-1-sulfonic acid	105.6					96	195-6	162 4		
143	5-Fluoronaphthalene-1-sulfonic acid Acenaphthene-3-sulfonic acid	105 6			284 6		122-3	196-7 196-9			Me ester, 118, eth  Me ester, 122-3, Et
	2,5-Dimethyl-4-nitrobenzene	140		143 5	204 0	143 5	75	197-8	131		ester, 137-9, lgr
	sulfonic acid 8-Chloronaphthalene-1-sulfonic			4 5		4 5	101 (96 8)	197 6			Me ester, 70, Et
147	, ,						52	201			ester, 67-8
148	sulfonic acid  5-Amino-2-hydroxybenzene sulfonic acid (4-Aminophenol- 2-sulfonic acid)	100 (anh)						202	159		Pyridine salt of O,N-diacetyl deriv, 143-4
149 150 151	4-Nitrobenzyl sulfonic acid Anthracene-1-sulfonic acid 6-Methylnaphthalene-2-sulfonic	71					90 90 97 8	204 205 205 6	220		deliv , 143-4
152	acid 4-lodonaphthalene-1-sulfonic acid						124 (121)	206 (204)	136		
153		100					86, chl	206	144		Et ester, 93
154	4-Aminonaphthalene-1-sulfonic acid (Naphthionic acid)		195					206			N-Acetyl deriv of amide, 241 N- Acetyl deriv of anilide, 231
155	4-Amino-2-nitrobenzene sulfonic acid						59-60	206 7			annue, 231
156	Retene-6-sulfonic acid	121-3					146-7 5	206 7 5			Me ester, 117 9, Et ester, 114 5
	2,6-Dimethyl-4-hydroxybenzene- 1,3-disulfonic acid						119	208	207		
158	4-(N-methylamino)benzene sulfonic acid 6-Chloronaphthalene-1-sulfonic	244 5 d					70	210-1			N-4-Toluenesulfonyl benzidine salt, 255 Et ester, 114-5
160	acid	105, grn			(202)		120-1, pınk, bz -	214, 50% al	202		2. 0500, 117 3
161	2,5-Dichlorobenzene-1,3-disulfonic						pet eth	215-7			

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

No	Name	Melting point, °C	S-Benzyl thiuro- nium salt	p-Tolui dinium salt	Anı linium salt	o-Tolui- dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon- anilide	Sulfon I naph- thylamide	Miscellaneous
162	5-Methylbenzene-1,3-disulfonic						94, eth	216, w	153, al		
163	acid Naphthalene-2-sulfonic acid	91, hyg	190 1	221	269	213	76 (79)	217 (213)	132		
164	4-Acetamidobenzene-1-sulfonic	)1, nyg	150 1	221	207		70(77)	218	152	215	
165	5-Aminonaphthalene-2-sulfonic acid		191					218 9 d	127-8		N-Acetyl, 238-9
166	8-Nitronaphthalene-2-sulfonic acid	135-6 (hyd)	!				169	223, 228	172–3		
167	5-Chlorobenzene-1,3-disulfonic acid	i	i				106	224			
168	2-Methylbenzene-1,4-disulfonic acid		i				98, bz - pet eth	dı 224	di 178	İ	
169	4-Carboxy-3-nitrobenzene sulfonic acid	111 (+2½- H <sub>2</sub> O)					di 160	di 226, mono-S 192			
170	5-Chloronaphthalene-1-sulfonic acid	1120)					95	226	138		Me ester, 89, Et ester, 46 Sulfonyl bromide, 110
171	3,4-Di-iodobenzene sulfonic acid	122 5, after drying at 100	i				82, bz - pet eth	227, aq al			Me ester, 93, al, Et ester, 82 5, al
172	2,4,6-Tribromobenzene sulfonic acid	64			! !		64	228	220-2		
173 174	4'-Nitrobiphenyl-4-sulfonic acid 3,4-Dichloro-2-methylbenzene sulfonic acid						178 52	228 228			
175	Benzene-1,3-disulfonic acid		214				63	229	148 50	245	Alkalı fusion → resorcinol, 110
176 177	Biphenyl-4-sulfonic acid 2,4-Di-iodobenzene sulfonic acid	162 (anh )					115 77 8	230 230	125		Me ester, 78, al, Et ester, 57, al
178	1-Ethoxybenzene-2,5-disulfonic acid		i				dı 106-8	dı 233			
179	Methane disulfonic acid (Methionic acid)					}	8, b p 133 <sup>10</sup>	dı 233	dı 192-3		Bp 220-70 <sup>10-15</sup> d
180	3,5-Dinitrobenzene sulfonic acid						99, chi - Igr	235, w , al			i
181	4-Aminobenzene-1,3-disulfonic acid (Aniline-2,4-disulfonic acid)	120 d						dı 235			
182 183	5-Iodonaphthalene-1-sulfonic acid				265		114 113	236 (239) 236	123		Me ester, 117 8,
184	4-Carboxybenzene sulfonic acid (4-Sulfobenzoic acid)	94 (hyd), 260 (anh)	213					dı 57	dı 236	di 252	
185	2,3-Dichloro-4-methylbenzene sulfonic acid	,					41	237			
186	6-Hydroxynaphthalene-2-sulfonic acid	167 (anh ), 129 (hyd )	217 (207)	248	264	208		237	161		
188	4-Methylbenzene-1,2-disulfonic acid						109-11, bz-pet eth	237 9	190, al		

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

	Nome	Melting	S-Benzyl thiuro-	o Tolui dinium	Anı-	p-Tolus- dinium	Sulfonyl	Sulfon	Sulfon-	Sulfon-	Miscellaneous
No	Name	°C	nium salt	salt	salt	salt	chloride	amide	anılıde	thylamide	Miscellatteous
189	4,5-Dimethylbenzene-1,3- disulfonic acid						79, yel, al	239	200, al		
190	4-Hydroxybenzene-1,3-disulfonic acid (Phenol-2,4-disulfonic acid)	> 100 d	}				di 89	dı 239	dı 205		
191	4-Methoxybenzene-1,3-disulfonic acid						86	240	209	1	
192	4-Acetamidonaphthalene-1-sul- fonic acid (Acetylnaphthionic acid)			232 3	231 2			241	231		
193	Naphthalene-2,7-disulfonic acid		212	299	251-2	238	158 (162), bz	242			
194 195	5-Nitrobenzene-1,3-disulfonic acid 2,4,6-Trimethylbenzene-1,3- disulfonic acid (Mesitylene						di 97 8 di 125	di 242 di 244	dı 150-1		
196	disulfonic acid)  2,3,4,6-Tetrabromobenzene sulfonic acid						96 5	ca 245 d			
197	4,6-Dimethylbenzene-1,3- disulfonic acid					<u> </u>	130, pet eth	249, w	196, 50°, al	<u> </u>	
198	1-Chloronaphthalene-2-sulfonic	130 3 d (anh)					84-5	250	171 2		Et ester, 104
199	Azobenzene-4,4'-disulfonic acid	169 d (anh )					di 222 (170)	<i>dı</i> 250 d			
200	Phenanthrene-2-sulfonic acid	150		291			156, ac a	253-4, al	157 8		Me ester, 101-2 (96-8), Et ester, 89, yel br, al
201 202	Benzene-1,2-disulfonic acid 2-Amino-5-methylbenzene-1,4- disulfonic acid	d at 290	206				143 di 156, chl	254 di 257, w	241 di 196-7, aq al		Imide, 186
203	5-Aminonaphthalene-1-sulfonic acid (Laurent's acid)		179					259-60	171		N-Acetyl deriv of aniline salt, 344
204	2-Methylbenzene-1,3-disulfonic acid					<u> </u>	88, bz	>260	162, al		
205	Anthracene-2-sulfonic acid						122, yel , tol	261	201		Me ester, 157, yel, Et ester, 160, Phenylhydrazide, 210
206	Anthraquinone-2-sulfonic acid		211	308	309		197, pa yel , bz	261, yel, ac a	193, yel -br		Me ester, 123, Et ester, 125
207	7-Nitronaphthalene-1-sulfonic acid			}			169 70	261 2	]		
209	Azoxybenzene-3,3 -disulfonic acid Naphthalene-1,4-disulfonic acid 4,6-Dichlorobenzene-1,3-disulfonic	126					138 160 (166) 123	273 273, w , al 276	179		
211	acid Benzidine-2,2'-disulfonic acid						Hydro- chloride, 205	278			
212	9,10-Dichloroanthracene-2- sulfonic acid						221	279	248		
213	4-Nitronaphthalene-2,7-disulfonic acid						di 140 1	di 286-7			
214	Benzene-1,4-disulfonic acid						131 (139)	288	249		
215	Azobenzene-3,4'-disulfonic acid						di 123 5	di 288			
216	Naphthalene-1,3-disulfonic acid 2,5-Dimethylbenzene-1,3- disulfonic acid						di 137 5 81, lgr	di 292 3 295, al	174, al		
218	Naphthalene-1,6-disulfonic acid	125 (anh )	81	314-5	298-9	323 4	129, bz	297-8			

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

No	Name	Melting point °C	S-Benzyl thiuro nium salt	p Tolui dinium salt	Anı lınıum salt	o Tolui dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon anilide	Sulfon I naph thylamide	Miscellaneous
219	Naphthalene-1,7-disulfonic acid						di 123	di 298 300			
220	Biphenyl-4,4 -disulfonic acid	72	171	330	Ì		203	300	1		
221	Naphthalene-2,6-disulfonic acid	-	256			i	225, bz	305	ļ		
222	Azobenzene-3,3 -disulfonic acid	}			)	j	166	305	}	)	
223	Naphthalene-1,5-disulfonic acid	240 5	257				di 183	di 310	di 249	1	Di-Me ester, 205,
1	l.	(anh)	(251)		}	Ì	1	(>340)	Í	}	chl
224	Benzene-1,3,5-trisulfonic acid	>100					tri 187	tri 310 5	tri 237		Tri-Et ester, 147,
225	Anthracene-1,5-disulfonic acid						di 249, pa yel	di > 330, yel	di 293		OZ.
226	Anthracene-1,8-disulfonic acid			i			225 yel,	333	224		
227	Anthraquinone-1,8-disulfonic acid	293 4					222 3, yel PhNO <sub>2</sub>	>340	237 8, yel , PhNO <sub>2</sub>		
228	Anthraquinone-1,5-disulfonic acid	310-1 (hyd), yel					265-70, yel, PhNO <sub>2</sub>	>350	269 70, red- yel,		
									PhNO <sub>2</sub>		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS b) M.p. of the amide deriv. not available; listed in order of increasing m.p. of the corresponding anilide deriv.\*

No	Name	Melting point, °C	S-Benzyl thiuron- ium salt	p-Tolui- dinium salt	Anı- lınıum salt	o-Tolui- dinium salt	Sulfonyl chloride	Sulfon- amide	Sulfon anilide	Sulfon- I-naph- thylamide	Miscellaneous
1	Ethane-1,2-disulfonic acid	104	201 2	270 d	270, w		di 95		69		m-Toluidide, 230, Di- Et ester, 77, eth
2	Vinylsulfonic acid (Ethylene- sulfonic acid)	<u> </u>	145 6, w		}	<u> </u>	bp 118 20 <sup>250</sup>		71,6 p		B p 135 <sup>2</sup> , n <sup>25</sup> 1 4505
3	Phenol-O-sulfonic acid 8-Aminonaphthalene-1-sul-	145 (hyd )	300	124-5	165				126 5-7 5 139 40		Anilinium salt of N-
5	fonic acid (Peri acid) 3,5-Dimethyl-2-hydroxyben- zene sulfonic acid	121 5 d			İ				142 3		acetyl deriv, 273 Chloride of O-acetyl deriv, 62, pet eth, Methylanilide, 111 2
6 7	Benzophenone-2-sulfonic acid 7-Hydroxynaphthalene-1,3,6- trisulfonic acid						96-7 196		143 5 152-5		
8	1-Hydroxynaphthalene-2-sul- fonic acid	>250	169						O-acetyl deriv,		O-acetyl deriv of p- toluidide, 135-6
9	2-Hydroxynaphthalene-1,6- disulfonic acid						di 111		157-8 di 191		
10	Anthraquinone-2,7-disulfonic acid						di 186, chl		di 192		
12	7-Hydroxynaphthalene-1,3- disulfonic acid (G-Acid)		228	294		271	eth 161-2		195		
13	7-Hydroxynaphthalene-1-sul- fonic acid (Bayer Acid)		218	232	240	242			195		
	4-Hydroxynaphthalene-1-sul- fonic acid (NW-Acid)	170, r h	103	196	186 7	203-4			199-200		2-Naphthylamide, 204
	5-Hydroxynaphthalene-1-sul- fonic acid 2-Hydroxynaphthalene-3,6-	110-2 d	233	250	254	257			201		Chloride of O-acetyl deriv, 129
10	disulfonic acid (R-Acid)		1233	230	234	231			202		
17	Anthraquinone-1-sulfonic acid	218	191		284		216 8, yel, PhNO <sub>2</sub>		214, gold- yel		$NH_3 \rightarrow 1$ -Aminoan- thraquinone, 252 (243)
18	Anthraquinone-1,6-disulfonic acid	215 7, gold, ac a					197 8, yel , PhNO <sub>2</sub>		227 8, yel, cl-bz		
19	2-Hydroxynaphthalene-1,5- disulfonic acid						di 177		di 231		
l	2-Hydroxynaphthalene-1,7- disulfonic acid			219			169		233		
21	Anthraquinone-1,7-disulfonic acid	120 (hyd )					231-2, br - yel , PhNO <sub>2</sub>		237 8, yel, cl-bz		
22	Anthraquinone-2,6-disulfonic acid						di 250, yel, cl-bz		di 321		

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides. Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives

Sulfonyl chloride

From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent For directions and examples see Cheronis, p. 638, Linstead, p. 89, Shriner, pp. 268, 270, Vogel, p. 553, Wild, p. 161

Sulfonamide \*

$$\begin{array}{cccc} RSO_3Na & \rightarrow & RSO_2Cl & \xrightarrow{NH_3} & RSO_2NH_2 \\ & & & & & \\ Sulfonyl & & & & \\ chloride & & & & \\ & & & & & \\ \end{array}$$

From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution For directions and examples see Linstead, p. 49, Shriner, pp. 268, 270 Vogel, p. 553, Wild, p. 161 From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

See Cheronis, p. 639

Sulfonanilide \*

From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide For directions and examples see Linstead, p. 89, Wild, p. 161
From the sulfonyl chloride and aniline
See Vogel, p. 553

Sulfon-p-toluidide \*

$$RSO_3Na \rightarrow RSO_2Cl \xrightarrow{p-CH_3C_6H_4NH_2} RSO_2NHC_6H_4CH_3-p + NaCl$$
Sulfonyl Sulfon p-toluidide chloride

From the sulfonyl chloride, p-toluidine and aqueous sodium hydroxide For directions and examples see Vogel, p 553

Sulfon-I-naphthylamide \*

From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene For directions and examples see Cheronis, p. 639

S-Benzylthiuronium salt \*

$$RSO_3Na + [C_6H_5CH_2SC(NH_2)_2]^+Cl^- \rightarrow [C_6H_5CH_2SC(NH_2)_2]^+RSO_3^- + NaCl \\ S-Benzylthiuronium chloride S-Benzylthiuronium sulfonate$$

From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

For directions and examples see Cheronis, pp. 635, 636, Linstead, pp. 15, 89 Shriner, p. 269, Wild, pp. 149, 159, E. Chambers and G. W. Watt, J. Org. Chem., 6, 376 (1941), E. Campaigne and C. M. Suter, J. Amer. Chem. Soc., 64, 3040 (1942), S. Veibel, J. Amer. Chem. Soc., 67, 1867 (1945)

#### \*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### EXPLANATIONS AND REFERENCES TO TABLE XXII AND XXIII (Continued)

From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol See J J Donleavy, J Amer Chem Soc, 58, 1004 (1936)

Anılınıum salt \*

$$RSO_3Na + C_6H_5NH_2 + HCI \rightarrow [C_6H_5NH_3]^+RSO_3^- + NaCI$$
Anilinium sulfonate

From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water

For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)

p-Toluidinium salt \*

RSO<sub>3</sub>Na + 
$$p$$
-CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>NH<sub>2</sub> + HCl  $\rightarrow$  [ $p$ -CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>NH<sub>3</sub>]<sup>+</sup>RSO<sub>3</sub><sup>-</sup> + NaCl  $p$  Toluidinium sulfonate

From the sulfonic acid and p-toluidine

For directions and examples see Shriner, p 269

From the sodium, potassium or ammonium salt with p-toluidine or p-toluidine hydrochloride in water See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942), A D Barton and L Young, J Amer Chem Soc, 65, 294 (1943)

From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with p-toluidine and hydrochloric acid

See Cheronis, p 637, Fieser, J Amer Chem Soc, 51, 2460 (1929)

o-Toluidinium salt \*

$$RSO_3Na + o\text{-}CH_3C_6H_4NH_2 + HCI \rightarrow [o\text{-}CH_3C_6H_4NH_3]^+RSO_3^- + NaCI$$

$$o\text{-}Toluidinium sulfonate}$$

From the sodium or the potassium salt of the sulfonic acid with o-toluidine and hydrochloric acid in water For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)

Phenylhydrazınıum salt \*

From the sulfonic acid with phenylhydrazine in water-alcohol

For directions and examples see Wild, p 159, P H Latimer and R W Bost, J Amer Chem Soc, 59, 2500 (1937)

Phenols by KOH fusion

$$ArSO_3Na + NaOH \rightarrow ArOH + Na_2SO_3$$
Phenol

By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible For directions and examples see Vogel, p 552

By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust See Linstead, p 89

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

						Ī.,, .	Salts	of the cor	respondin	g acid	
No	Name	Melting point °C	Sulfonic acid	Amide	Anihde	l Naph thyl amide	S Benzyl thru ronium	p-Tolui dine	Aniline	o Tolui- dine	Miscellaneous
1 .	Methanedisulfonyl chloride	8	b p 220 70 <sup>15</sup> 20 d	233	192-3						Bp 133 <sup>10</sup>
	2-Ethylbenzenesulfonyl chloride 3-Methylbenzenesulfonyl chloride (Toluene-3-sulfonyl chloride)	11 7 12		100 108, al	96						
4	4-Ethylbenzenesulfonyl chloride	12		110							N-Xanthylsulfon amide 196
5	Benzenesułfonyl chloride	14 5	43 4 (mono- hyd) 66 (anh)	156, 153		170 1	148	205	240	176	N-Xanthylsulfon- amide, 200
6 7	Heptane-1-sulfonyl chloride 2,6-Dichloro-3-methylbenzene- sulfonyl chloride	16 19 5		75 188	- - -						
8	3-Carboxybenzenesulfonyl chloride	20	98 (hyd), 148 (anh )	di 170			163	224 6	 		The m p is that of the 1,3-dichloride
9	3,4-Dichlorobenzenesulfonyl chloride	22 4 19		140 135							
10	5-Chloro-2-methylbenzenesulfonyl chloride	24		145, aq al							
(	2,5-Dimethylbenzenesulfonyl chloride	24 6	48 (апћ ) 86 (hyd )	148			184				N-Xanthylsulfon- amide, 176
1	2-Chlorobenzenesulfonyl chloride	28 5		188						Ì	
- 1	2-Phenylethane-1-sulfonyl chloride 5-Bromo-2-methylbenzenesulfonyl	33 33 5	91	122 166 7	77						
15	chloride 2,4-Dimethylbenzenesulfonyl chloride	34	62 (hvd)	110							
16	3,4-Dibromobenzenesulfonyl chloride	34	66 5 7 5 (anh)	175							
17	2,4,6-Trichlorobenzenesulfonyl chloride	35 40	(/	210 2d					,		
ļ	4-Methyl-3-nitrobenzenesulfonyl chloride	36	92, hyg	144 5	109	153		130-1		28	
	4-Fluorobenzenesulfonyl chloride	36, 30		125							
	3-Ethoxybenzenesulfonyl chloride 3-Chloro-4-methylbenzenesulfonyl	38 38		131 134	96						
)	chloride 2,5-Dichlorobenzenesulfonyl	38	93-7	181	160	160	170	247-8	262 3	250 1	
23	chloride  2,6-Dimethylbenzenesulfonyl chloride	39	98	113 96							
24	4-Ethoxybenzenesulfonyl chloride	39		150		} }					
25	4-Chloro-3-nitrobenzenesulfonyl	40 1		175 6							
26	chloride 2,3-Dichloro-4-methylbenzene-	60-2 41		yel al 237							
27	sulfonyl chloride 4,6-Dichloro-2-methylbenzene-	43		168	:						
28	sulfonyl chloride 3,3-Dimethylbutane-1-sulfonyl chloride	43 4		96 7							
29	Propane-1,3-disulfonyl chloride	45	92d	169, w	di 125						Dı-m-toluidide 222
30	2-Chloro-4-methylbenzenesulfonyl	46, 52		186							
31	chloride Indane-5-sulfonyl chloride	46-7, eth	92	135 5-6, al	129, al			į			
32	2-Methyl-5-nitrobenzenesulfonyl chloride	46-7	133 5 (+2H₂O)	186	148			256-7		256-8	B p 183 510
<b>3</b> 3	2,3-Dimethylbenzenesulfonyl chloride	47	(121120)	167							

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

				<u> </u>			Salts	of the cor	respondin	g acıd	
No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naph- thyl amide	S Benzyl thiu ronium	p-Tolui dine	Aniline	o-Tolui dine	Miscellaneous
34	4-Bromo-3-methylbenzenesulfonyl	50		146							
35	chloride 3-Methyl-4-nitrobenzenesulfonyl	50		133 5							
36	chloride 4-Bromo-2-methylbenzenesulfonyl	50		168	į	}	}				
37	chloride 4-Chloro-2,5-dimethylbenzene-	50	100	185	155						
38	sulfonyl chloride 2-Bromobenzenesulfonyl chloride	51, eth		186 w		į					
39	3,4-Dichloro-2-methylbenzene- sulfonyl chloride	51 2		228							
40	3,4-Dimethylbenzenesulfonyl chloride	52	64 55	144			208				
41	4-Chloro-3-methyl-5-nitrobenzene- sulfonyl chloride	52		201	i						
42 43	4-Chlorobenzenesulfonyl chloride Indane-4-sulfonyl chloride	53 53 3 5	69 93	144 118 9, w	104	190	175	208-10	222 3	163 4	<b>B</b> p 140 i
	4-Methylbenzene-1,3-disulfonyl chloride (Toluene-2,4-disulfonyl	54 46		di 186-7 191	189						-
45	chloride) 4-Chloro-2-methylbenzenesulfonyl	54		185							
46	chloride 3,5-Dichloro-2-methylbenzene- sulfonyl chloride	54		186					!		
47	Hexadecane-1-sulfonyl chloride	54	54	97				204 (		170.3	
	2,4-Dichlorobenzenesulfonyl chloride	55	86	182				204 6		170-2	
	4-Bromo-3-nitrobenzenesulfonyl chloride	55 7		176 7							
1	2,4,6-Trimethylbenzenesulfonyl chloride	56	78	142	109						
	2-Chloro-5-methylbenzenesulfonyl chloride	56		156	229 30 5	! ]					
	2,6-Dichloro-4-methylbenzene- sulfonyl chloride	56		154 5							
53	4-Carboxybenzenesulfonyl chloride		94 (hyd ), 260 (anh )	di 236	di 252						The m p is that of the 1,4-dichloride
54 55	Tetralin-6-sulfonyl chloride 3-Methyl-2-nitrobenzenesulfonyl chloride	58 58 5		135 163 5	155 6						
56	5-Carboxy-2-methylbenzenesul- fonyl chloride (4-Toluic acid-2-	59	190, 158 (anh )	185							The m p is that of the 1,5-dichloride
57	sulfonyl chloride) 4-Amino-3-nitrobenzenesulfonyl chloride (2-Nitroaniline-4-	59-60	}	206-7							
58	sulfonyl chloride) 5-Chloro-2-methyl-3-nitrobenzene-	60		167							
59	sulfonyl chloride 3-Bromo-4-methylbenzenesulfonyl chloride	60		151							
60	2,5-Dimethyl-3-nitrobenzene- sulfonyl chloride	61	128,200	173	143 4			136			
61	2,4,5-Trimethylbenzenesulfonyl chloride	61	112	181							
62	Benzene-1,3-disulfonyl chloride	63	i	229	148 50	245	214				N-Xanthylsulfon- amide, 170 Alk fusion → resor-
63	4-Chloro-3-methylbenzenesulfonyl chloride	63		128	92						cinol, 110

<sup>\*</sup>Derivative data given in order in p , crystal color, solvent from which crystallized

						1 Naph-	Salts	of the cor	responding	g acıd	
No	Name	Melting point °C	Sulfonic acid	Amide	Anılıde	thyl amide	S-Benzyl thiu ronium	p-Tolui- dine	Aniline	o Tolui- dine	Miscellaneous
64	7-Methylnaphthalene-2-sulfonyl chloride	63 4		163-4							
65	2,4,6-Tribromobenzenesulfonyl chloride	64	64	228	220-2d						
66	3-Nitrobenzenesulfonyl chloride	64	48	167	126	166 5	146	222	126 5- 7 5	193	
67	2,3,4-Trichlorobenzenesulfonyl chloride	64-5		227-30							
68	3-Bromocamphor-10-sulfonyl chloride	65	47 5	156	}						
70	2-Ethoxybenzenesulfonyl chloride	65 6		163	158						
71	4-Methoxy-3-nitrobenzenesulfonyl chloride	66		146 3							
72 73	,	67 68	193 57	132 156 3	121 88 136		170	203-4	218		N-Xanthylsulfon-
74	(Toluene-2-sulfonyl chloride) Naphthalene-1-sulfonyl chloride	68, 66	90	150	112 152	ļ	137	181	183	237	amide, 182 3 5
75	4-Methylbenzenesulfonyl chloride (Toluene-4-sulfonyl chloride)	69	104 5	138 5 9 (anh), 105 (+2H,O)	103	157	181-2	198	238	190	
76 77	2-Nitrobenzenesulfonyl chloride 3,5-Dichloro-4-methylbenzene-	69 69	70 85	193 191	115						
78	sulfonyl chloride  2,4-Dimethoxybenzenesulfonyl chloride	70		167		ļ 					
79	6-Chloronaphthalene-1-sulfonyl chloride	70		214							
80		70		180							
	2,5-Dibromobenzenesulfonyl chloride	71	128 (anh )	195							
	3,6-Dichloro-2,5-dimethylbenzene- sulfonyl chloride	71		165	171						
84	3-Chloro-2-methylbenzenesulfonyl chloride 4-Methoxynaphthalene-2-sulfonyl	72, pet eth 75	60-72	180, w	145						
85	chloride 2-Chloronaphthalene-1-sulfonyl	75		153	143						
	chloride 4-Chloro-2-nitrobenzenesulfonyl	75	82	164, 237	138						Phenylhydrazide
87	chloride 2,5-Dimethyl-4-nitrobenzene-	75	140	197-8	131			143 5		143 5	151, Ph ester, 82
88	sulfonyl chloride 4-Bromobenzenesulfonyl chloride	76, eth	88 90	166, 161	119	183 5	170	4 5 215 6	237-8	4 5 182-3	
89	Naphthalene-2-sulfonyl chloride	76, 79	91, hyg ,	217, 213	132	163 3	190 1	221	269	213	
90	6-Bromonaphthalene-1-sulfonyl chloride	77	122	217							
91	2,4-Di-iodobenzenesulfonyl chloride	77–8	167 (anh )	230							Me ester, 78, al, Et ester, 57, al
	2-Carboxybenzenesulfonyl chloride	79, pet eth	68 9 (hyd), 134 (anh)		194–5		206	196 200	165	127-8	The m p is that of the 1,2-dichloride
93	2,4-Dibromobenzenesulfonyl chloride	79, eth	110 (anh )	190							
94	4,5-Dimethylbenzene-1,3-disul- fonyl chloride	79, yel		239	200, al						

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

				1		T	Salts	of the cor	respondin	g acıd	
No	Name	Melting point °C	Sulfonic acid	Amide	Anılıde	I-Naph thyl amide	S Benzyl thiu ronium	p-Tolui dine	Aniline	o-Tolut- dine	Miscellaneous
95	4-Nitrobenzenesulfonyl chloride	80 lgr	109 11 95 hyg	180, 50°。 al	171 136 d			179 80			
96	6-Methoxynaphthalene-1-sulfonyl chloride	80 5	.,,,,	149 5	177 5						
97	2,5-Dimethylbenzene-1,3-disul- fonyl chloride	81, lgr		295 al	174 al						
98		81		150	175						
99	4-Methylnaphthalene-1-sulfonyl chloride	81, eth		174 177 al	158						
100	3,4-Dı-iodobenzenesulfonyl chloride	82, bz pet eth	122 5	227, aq al							
101	3-Chloro-4-methoxybenzenesul- fonyl chloride	82		131							
102	7-Methoxynaphthalene-2-sulfonyl chloride	83		220	121						
103	2-Methylnaphthalene-1-sulfonyl chloride	83 5		124	i I						
104	1-Chloronaphthalene-2-sulfonyl chloride	84 5	130 3d (anh )	250	171 2						
105 106	4-Ethoxynaphthalene-2-sulfonyl	85 85		183 183	143 143 5						
107	chloride 4,5-Dichloro-3-methylbenzene- sulfonyl chloride	85 8		183 5							
108	4-Methoxybenzene-1,3-disulfonyl chloride	86		240	209						
109	4-Fluoronaphthalene-1-sulfonyl chloride	86	100 (hyd )	206	144					:	Et ester, 93
110	7-Chloronaphthalene-2-sulfonyl chloride	87	68 (tetra- hyd ) 118 (anh )	76							Me ester, 89, Et ester, 65
111	4-Bromonaphthalene-1-sulfonyl chloride	87		195							
112 113	D-Camphor-3-sulfonyl chloride 2-Methylbenzene-1,3-disulfonyl chloride	88 88	77	143 260	124 162			196 7			Me ester, 77
114	8-Methylnaphthalene-2-sulfonyl chloride	88		116							
115	4-Hydroxybenzene-1,3-disulfonyl chloride (Phenol-2,4 disulfonyl chloride)	89	>100d	239							
116	3,5-Dimethyl-2-hydroxybenzene- 1,3-disulfonyl chloride	89 91		160 1							
117 118	Anthracene-1-sulfonyl chloride 2-Chloro-5-nitrobenzenesulfonyl	90 90, w	168 9d	205 185 6							
119 120	chloride Quinoline-6-sulfonyl chloride Benzylsulfonyl chloride	91 92 3, eth ,	(hyd ) >260	192 105, w, al	102	166		113, al	102	83	Hydrazide, 131 2,
121	6-Iodonaphthalene-1-sulfonyl	lgr 92 5		213		146					Phenylhydrazide, 173
122	chloride 6-Methoxynaphthalene-2-sulfonyl	93		189	120						
123	chloride 5-Chloro-2-nitrobenzenesulfonyl	93		159							
124	chloride 1-Bromonaphthalene-2-sulfonyl chloride	93		271							

<sup>\*</sup>Derivative data given in order mp, crystal color solvent from which crystallized

		<u> </u>		<u> </u>	1	T	Salts	of the cor	respondin	g acıd	
No	Name	Melting point °C	Sulfonic acid	Amide	Anılıde	I-Naph- thyl amide	S-Benzyl thiu- ronium	p-Tolui dine	Aniline	o Tolui dine	Miscellaneous
125	5-Methylbenzene-1,3-disulfonyl chloride	94, eth		216, w	153, al						
126	3,5-Dimethylbenzenesulfonyl chloride	94, 90, bz		135, al	129, al			121 2, al			
127		94		185				-			
128	I-Iodonaphthalene-2-sulfonyl chloride	94		247							
129	4-Chloronaphthalene-1-sulfonyl chloride	94 5	130 3d	187		162				151	o Toluidide 145 6 Me ester 83 Et ester, 104
130	Ethane-1,2-disulfonyl chloride	95		69			201 2	270d	270, w		Di-Et ester 77 eth m-Toluidide 230
131	5-Bromonaphthalene-1-sulfonyl chloride	95		232 3					}		
132	5-Chloronaphthalene-1-sulfonyl chloride	95		226	138						Sulfonyl bromide, 110, Me ester, 89, Et ester, 46
133	7-Methylnaphthalene-1-sulfonyl chloride	96		195 6	162 4						2. 2,
134	2,4-Dimethyl-3-nitrobenzene- sulfonyl chloride	96	144 (anh )	172							
135	5-Bromonaphthalene-2-sulfonyl chloride	96		220							
136	<b>2-Benzoylbenzenesulfonyl chloride</b> (Benzophenone 2-sulfonyl chloride)	96 7			143 5						
137	2,3,4,6-Tetrabromobenzenesul- fonyl chloride	96 5		245d							
138	10-Bromocamphor-3-sulfonyl chloride	97		100 2							
139	6-Fluoronaphthalene-2-sulfonyl chloride	97 chl	105 (hyd )	133	129		190 1	221	269	213	
140	2-Bromonaphthalene-1-sulfonyl chloride	97		140							
141	6-Methylnaphthalene-2-sulfonyl chloride	97 8		205 6							
142	5-Nitrobenzene-1,3-disulfonyl chloride	97 8		242							
143	2,4-Dimethyl-5-nitrobenzene- sulfonyl chloride	98	132 122 dil HNO <sub>3</sub>	187 179							Sulfonyl fluoride, 109-10
144	2-Methylbenzene-1,4-disulfonyl chloride	98		224	di 178						
145	4-Methyl-3-nitrobenzenesulfonyl chloride	98 9		170					!		o Anisidide, 135
146	4-Methoxynaphthalene-1-sulfonyl chloride	98 5		226	147 5						
147	5-Chloro-4-methyl-2-nitro- benzenesulfonyl chloride	99	128	181		İ					
148	3,5-Dinitrobenzenesulfonyl chloride	99, chl, lgr		235							
149	4-Nitronaphthalene-1-sulfonyl chloride	99		188							
150	7-lodonaphthalene-2-sulfonyl chloride	100		210	ĺ						
151	7-Bromonaohthalene-2-sulfonyl chloride	100		218							

<sup>\*</sup>Derivative data given in order im pi, crystal color, solvent from which crystallized

						I-Naph-	Salts	of the cor	responding	g acıd	
No	Name	Melting point °C	Sulfonic acid	Amide	Aminde	thyl amide	S Benzyl thiu ronium	p Tolui- dine	Aniline	o-Tolui- dine	Miscellaneous
152	3-Nitrobenzylsulfonyl chloride	100, bz	74 (hyđ )	159 d , w							Me amide 106 7 Dimethylamide 118 9
153	8-Chloronaphthalene-1-sulfonyl chloride	101		197							,,,,,
154	2,4-Dinitrobenzenesulfonyl chloride	102	106 8 (hyd) 130 (anh)	157 154							Hydrazide, 110
155	4-Nitrodiphenylamine-2-sulfonyl chloride	102 4	130 (4 )	173	164						
156	4-Ethoxynaphthalene-1-sulfonyl chloride	103		170	180						
157	7-Ethoxynaphthalene-2-sulfonyl chloride	103		142	153						
ı	3,7-Diethylnaphthalene-1-sulfonyl chloride	105 7		207							
159	5,6-Dichloronaphthalene- 1-sulfonyl chloride	106		223							
1	4-Chloronaphthalene-2-sulfonyl chloride	106		168							Et ester 76 9
į	2-Methyl-4-nitrobenzene- sulfonyl chloride	106	_	157							
- 1	DL-Camphor-8-sulfonyl chloride 5-Chlorobenzene-1,3-disulfonyl chloride	106 106	56 8	133 5, w 224							
164	3-Ethoxybenzene-1,4-disulfonyl chloride	106 8		di 233							
165	6-Ethoxynaphthalene-2-sulfonvl chloride	107 5		183	153						
166	4-Methylbenzene-1,2-disulfonyl chloride	109 11		237 9	190						
167	2,5-Dimethyl-6-nitrobenzene- sulfonyl chloride	110	145 (anh )	192	182			158 5 9		143 5 50/ <sub>4</sub> al	
168	2-lodonaphthalene-1-sulfonyl chloride	110		154							
169	Phenanthrene-3-sulfonyl chloride	110-1	175 6 (anh) 120 1(+1 H <sub>2</sub> O) 88d (+2H <sub>2</sub> O)	190			222				Me ester 119 20, al Et ester 107 8
170	6-Chloronaphthalene-2-sulfonyl chloride	110 5		184							
171	2-Hydroxynaphthalene-1,6- disulfonyl chloride	111			di 191						
172	· ·	111	,	223	178						
173	3-Hydrox ynaphthalene-2-sulfonyl chloride	112		110					241 2		
174	5-Nitronaphthalene-1-sulfonyl chloride	113		236	123			1			
175	Acenaphthene-3-sulfonyl chloride	113 4	87 9	199	284 6						Me ester, 122 3, Et ester, 137 9, Igr
176	2,5-Dichlorobenzene-1,3- disulfonyl chloride	114		215 7							·v·
177	5-Chloronaphthalene-2-sulfonyl chloride	115		216							
178	Biphenyl-4-sulfonyl chloride (4- Phenylbenzenesulfonyl chloride	115		230	125						

<sup>\*</sup>Derivative data given in order in p , crystal color, solvent from which crystallized

							Salts	of the cor	respondin	g acid	
No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	I-Naph thyl amide	S-Benzyl thiu ronium	p-Tolui dine	Aniline	o-Tolui dine	Miscellaneous
179		116		158	187						
180	chloride 4,5-Dichloronaphthalene-	117	Ē	229		}					ı
181	1-sulfonyl chloride 2,6-Dimethyl-4-hydroxybenzene-	117 8		206-8	205 7				İ		!
182	1,3-disulfonyl chloride 6-Ethoxynaphthalene-1-sulfonyl	118		154	194 5						
183	chloride 4,6-Dichloronaphthalene-	119		226			i		,		
184	1-sulfonyl chloride 5-Methoxynaphthalene-	119 5		194 5	157						
185	1-sulfonyl chloride 5-Methylnaphthalene-2-sulfonyl	120 2	}	188 9	248-50,						
186	chloride 8-Bromonaphthalene-2-sulfonyl	121		187	133-4						
187	chloride 5-Ethoxynaphthalene-1-sulfonyl	121		182 5	130						
188	chloride 2-Methoxynaphthalene- 1-sulfonyl chloride	121		159	196 5				]		
189	1-Nitronaphthalene-2-sulfonyl chloride	121, pink, bz -pet	105, lgr	214	202						
190		eth 121		228							
191	2-sulfonyl chloride 2-Chloro-5-methyl-6-nitro-	122	)	177							
192	benzene sulfonyl chloride Anthracene-2-sulfonyl chloride	122		261	201		!				Me ester, 157, Et
193	5-Fluoronaphthalene-1-sulfonyl	122-3	105 (hyd )	196 7							ester, 160 Me ester, 118, eth
194	chloride 4,6-Dichlorobenzene-	123	_	276							
195	1,3-disulfonyl chloride Azobenzene-3,4'-disulfonyl	123 5		dı 288							
196	chloride 7,8-Dichloronaphthalene-	124		227							
197	2-sulfonyl chloride 4-Iodonaphthalene-1-sulfonyl	124, 121		206, 204	136						
198	chloride 6-Bromonaphthalene-2-sulfonyl chloride	124		127	ļ						
199	Quinoline-8-sulfonyl chloride	124	312	183–4			ĺ				Me ester, 96, Et ester, 73
200	4-Methylnaphthalene-2-sulfonyl chloride	124 5		143-4							
201	1,5-Dichloronaphthalene-1- sulfonyl chloride	125		282							
202	2,4,6-Trimethylbenzene-1,3- disulfonyl chloride	125		dı 244	di 150 1						
203	5-Nitronaphthalene-2-sulfonyl	125	118-9, yel	184							
204	6-Nitronaphthalene-1-sulfonyl chloride	127		223-4							
205	Phenanthrene-9-sulfonyl chloride	127	174 (anh )	193–4				235			Me ester, 106, me al, Et ester, 108
206	Naphthalene-1,6-disulfonyl	129	125 (anh )	298			81,	314-5	298-9	323-4	al
207	chloride 7-Chloronaphthalene-1-sulfonyl chloride	129		235			235				

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

_							Salts	of the cor	respondin	g acıd	
No	Name	Melting point, °C	Sulfonic acid	Amide	Anihde	l Naph- thyl amide	S-Benzyl thru- rontum	p-Tolui dine	Aniline	o-Tolui- dine	Miscellaneous
208	4,6-Dichloronaphthalene-2-	130		218							
209	sulfonyl chloride 2,4,5-Trimethoxybenzenesulfonyl	130		76	170						
210	chloride 4,6-Dımethylbenzene-1,3-di-	130, pet		249, w	196, 50%					ļ	
211	sulfonyl chloride 5,6,7-Trichloronaphthalene-1-	eth 131		249	al					<u> </u>	
212	sulfonyl chloride	131 139		288	249						
213	5,8-Dichloronaphthalene-2-	134		244	247						
214	sulfonyl chloride 3,7-Dichloronaphthalene-1-	136		269						<u> </u>	
215	sulfonyl chloride 3-Bromocamphor-8-sulfonyl chloride	136 7		į						}	
216	8-Chloro-7-methoxynaphthalene- 1-sulfonyl chloride	137		153	196						
217	Benzophenone-3,3 -disulfonyl chloride	137 8		dı 157	di 177 8						N-Xanthylsulfon amide, 197
218		137 5		di 292 3							annue, 197
219	7,8-Dichloronaphthalene-1- sulfonyl chloride	138		221							
220	1	138	126	dı 273							
221 222	D-Camphor-8-sulfonyl chloride 3-Methoxynaphthalene-2-sulfonyl	138 138		137 113	174						1
223	chloride	139		333 4							
224	chloride 4-Nitronaphthalene-2-sulfonyl	139 5		225							
225	chloride 6-1odonaphthalene-2-sulfonyl	140	<u> </u>	222					i		
226	chloride 8-10donaphthalene-1-sulfonyl	140	115	187							
227	chloride 4-Nitronaphthalene-2,7-disulfonyl	140 1		286-7	]					 	
228	chloride 4-Hydroxybenzenesulfonyl	141		176-7			169	202	170	192	
229	chloride 4,8-Dichloronaphthalene-2-	141		205							
230	sulfonyl chloride 5-lodonaphthalene-1-sulfonyl	141		239		!					
231	chloride Pyridine-3-sulfonyl chloride	Hydro chloride,	357	110 1	145	!					Hydrazide, 94
232	6,7-Dichloronaphthalene-1-	141 4 142		268							
233	sulfonyl chloride Benzene-1,2-disulfonyl chloride	143	i	254	241						
234		146		218		!					
235	· ·	146 7 5, yel -br	121 3	206 7 5		,					
236	7-Bromonaphthalene-1-sulfonyl chloride	147		209							
237	4-Acetamidobenzenesulfonyl	149		219	214	215					
238	chloride 5,7-Dichloronaphthalene- 1-sulfonyl chloride	149		272							

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

		<u> </u>			<u> </u>		Salts	of the cor	responding	g acıd	
No	Name	Melting point °C	Sulfonic acid	Amide	Amhde	1 Naph- thyl amide	S-Benzyl thiu ronium	p-Tolui- dine	Aniline	o-Tolus- dine	Miscellaneous
239	4,5-Dibenzylnaphthalene-	151		168							
240	1-sulfonyl chloride 4,7-Dichloronaphthalene-	151		217			1	:			
	1-sulfonyl chloride 7-Ethoxy-8-nitronaphthalene-	155		173 4					ļ		
	1-sulfonyl chloride	ŀ			1. 104. 7					ļ	
242	disulfonyl chloride	156, chl		di 257, w	<i>dı</i> 196-7, aq al						
243	Phenanthrene-2-sulfonyl chloride	156	150	253-4	157-8			291			Me ester, 101 2, Et ester, 89, yel -br
244	4,7-Dichloronaphthalene-2- sulfonyl chloride	156		196							
245	6,7,8-Trichloronaphthalene-2- sulfonyl chloride	157	]	245							
246	4,5-Dichloronaphthalene-2-	158		197							
247	sulfonyl chloride 5,6,8-Trichloronaphthalene-2-	158		235							
248	sulfonyl chloride Naphthalene-2,7-disulfonyl	158, 162		242			212	299	251-2	238	
249	chloride Naphthalene-1,4-disulfonyl	160 166		273, w ,	179						
250	chloride 4-Carboxy-3-nitrobenzene-	di 160	111	or al 192							The m p is that of
İ	sulfonyl chloride	i	(+2⅓ H <sub>2</sub> O)	1	[	l					the 1,4-dichloride, Diamide, 226
251	7-Hydroxynaphthalene-1,3- disulfonyl chloride	161 2			195	!	228	294		271	<i>S.</i> (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)
252	Fluorene-2-sulfonyl chloride	164	155 (hyd.)	213d	į į						
253	2,5-Dimethylbenzene-1,4- disulfonyl chloride	164		310	223		<u> </u>				
254	8-Nitronaphthalene-1-sulfonyl chloride	165 d	115 d (+3H₂O)	191	178 8 5			ļ		i	
255	7-lodonaphthalene-1-sulfonyl	165	(+3H <sub>2</sub> O)	240	 					į	
256	,	166		di 305							
257	chloride 3,6-Dichloronaphthalene-2-	166		218							
258	sulfonyl chloride 5,6-Dichloronaphthalene-2-	167		192							
259	sulfonyl chloride Phthalic acid-4-sulfonyl chloride	167-70, d	138 40	192-200							
	(3,4-Dicarboxybenzenesulfonyl chloride)	eth	(+1H <sub>2</sub> O)	d , w							
260	8-Nitronaphthalene-2-sulfonyl	169	135-6	223	172-3						
261	chloride 4-Amıno-2-hydroxybenzene-	169	(+1½ H₂O)	155							
262	sulfonyl chłoride 2-Hydroxynaphthalene-1,7-	169		233							
263	disulfonyl chloride	169-70		261-2							
	chloride 4,6,7,8-Tetrachloronaphthalene-2-	176		235							
	sulfonyl chloride					i					
	4'-Nitrobiphenyl-4-sulfonyl chloride	178		228							
266	Naphthalene-1,5-disulfonyl chloride	183	245 (anh )	310, 340	249		257, 251	332			D1-Me ester, 205, chl
267	Anthraquinone-2,7-disulfonyl chloride	186, chl			dı 192		d				

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

							Salts	of the cor	respondin	gacid	
No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	l Naph thyl amide	S Benzyl thiu ronium	p-Tolui dine	Aniline	o-Tolui dine	Miscellaneous
268	Benzene-1,3,5-trisulfonyl chloride	187		tri 310 5	tri 237						Tri-Et ester, 147,
269	7-Hydroxynaphthalene-1,3,6- trisulfonyl chloride	196			152 5						
270	Anthraquinone-2-sulfonyl chloride	197		261	193		211	308	309		Me ester, 123, Et ester, 125
271	Anthraquinone-1,6-disulfonyl chloride	197 8,yel , PhNO₂	215 7, gold	<u>.</u>	227 8, yel						
272	Biphenyl-4,4'-disulfonyl chloride	203		300			171	330 d			
273	Benzidine-2,2'-disulfonyl chloride	Hydro- chloride, 205		di 278							
274	Anthraquinone-1-sulfonyl chloride	216 8, yel , PhNO <sub>2</sub>	218		214		191		284		NH <sub>3</sub> → I-Amino- anthraquinone, 252, 243
275	9,10-Dichloroanthracene-2- sulfonyl chloride	221		279	248						
276	Azobenzene-4,4'-disulfonyl chloride	222	169d (anh)	250 d				ļ			Et ester, 104
277	Anthraquinone-1,8-disulfonyl chloride	222 3, yel, PhNO <sub>2</sub>	293-4	>340	237-8, yel, PhNO <sub>2</sub>						
278	Anthracene-1,8-disulfonyl chloride	225		333	224	<u> </u>	ì		Ì	1	
279	Naphthalene-2,6-disulfonyl chloride	225		305			256		360		
	2-Hydroxynaphthalene-1,5- disulfonyl chloride	231			231						
- 1	Anthracene-1,5-disulfonyl chloride	240		di 330	di 293						
282	Anthraquinone-2,6-disulfonyl chloride	250, yel cl bz			di 321						
283	Anthraquinone-1,3-disulfonyl chloride	265 70, yel	310 1 (hyd)	> 350	269 70, yel -red				}		
284	2,4-Diaminobenzene-1,5-disulfonyl chloride	275		187	236						
285	Anthraquinone-1,7-disulfonyl chloride	301 2, br - yel, PhNO <sub>2</sub>	120 (hyd )		237-8, yel						

 $<sup>{}^{</sup>ullet}$ Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

#### **EXPLANATIONS AND REFERENCES TO TABLE XXIV**

Formation of sulfonic acid by hydrolysis \*

RSO<sub>2</sub>NH<sub>2</sub> + H<sub>2</sub>O 
$$\xrightarrow{\text{HCl}}$$
 RSO<sub>3</sub>H + NH<sub>4</sub>C Sulfonic

From hydrolysis of the sulfonamide by 25% hydrochloric acid.

For directions and examples see Cheronis, p. 631, Shriner, pp. 104, 267, R. S. Schreiber and R. L. Shriner, J. Amer. Chem. Soc., 56, 1618 (1934).

From hydrolysis of the sulfonamide in a mixture of concentrated sulfuric acid and 85% phosphoric acid See Cheronis, p. 633.

Formation of the amine by hydrolysis

$$2 \text{ ArSO}_2 \text{NHR} + 5 \text{ HBr} + 5 \text{ C}_6 \text{H}_5 \text{OH} \rightarrow \text{ArSSAr} + 2 \text{ RNH}_2 + 5 \text{ p-BrC}_6 \text{H}_4 \text{OH} + 4 \text{ H}_2 \text{O}$$
Amine

From hydrolysis of the sulfonamide in 48% hydrobromic acid and phenol.

For directions and examples see Shriner, pp. 105, 267, H. R. Snyder and R. E. Heckert, J. Amer. Chem. Soc., 74, 2006 (1952); H. R. Snyder and H. C. Geller, J. Amer. Chem. Soc., 74, 4864 (1952).

*NOTE* For directions and explanations for the preparation of derivatives of the sulfonic acid formed by the hydrolysis of the sulfonamide see explanations and references to Table XXII, pp. 369, 370.

For directions and explanations for the preparation of the amine formed by the hydrolysis of the sulfonamide see explanations and references to Table XVIII, pp. 291, 292, 293

N-Xanthylsulfonamide \*

From the sulfonamide and xanthydrol in glacial acetic acid.

For directions and examples see. Cheronis, p. 634, Linstead, p. 95; Shriner, p. 267; R. F. Phillips and V. S. Frank, J Org Chem, 9, 9 (1944).

N-Acetylsulfonamide.

$$RSO_2NH_2 + (CH_3CO)_2O \rightarrow RSO_2NHCOCH_3 + CH_3COOH$$
  
 $RSO_2NHR' + CH_3COCI \rightarrow RSO_2NR'COCH_3 + HCI$   
N-Acetyl-  
sulfonamide

From the sulfonamide and acetic anhydride.

For directions and examples see. Cheronis, p. 634.

From the sulfonamide and acetyl chloride in acetic acid.

See. Linstead, p. 95; Vogel, p. 555.

<sup>\*</sup>Derivatives recommended for first trial

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)\*

		<del></del>	T	Deriva	tives of the co	rresponding	acıd	Salte	of the cor	responder	ne acid	<u> </u>
				Deriva	tives of the co	Tesponding	T T		T the con	Tespondii	ig acid	Miscellaneous
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Amilide	1-Naph thyl- amide	S Benzyl thiu ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	derivatives of the acid
1	2-Methylpropane-1- sulfonamide	14-6		b p 8013		38	107					
2	N,N-Diethylbenzylsul- fonamide	29		92	105, w, al	102	166 (146)		113, al	102	83	
3	2-Methylpropane-1- sulfonanilide	38		bp 8013	14-6		107					
4	3-Methylbutane-1- sulfonanilide	42		bp 9813	3		90 1					
5	Butane-1-sulfonamide	45	-15	bp 7510		10 5	60 5					Phenylhydrazı- nıum salt, 114-5
6	Propane-1-sulfonamide	52, eth	7 5	bp 7815		10	84		67-8			Phenylhydrazı- nıum salt, 204 5d
7	Ethane sulfonamide	58, eth	-17	bp 178		58	66	115				Phenylhydrazı- nıum salt, 182 8
8	Ethane sulfonanilide	58	-17	bp 178	58	l	66	115			ļ	Phenylhydrazı- nıum salt, 182 8
9	N,N-Diethyltoluene-4- sulfonamide	60	104-5	69	105 (dihyd), 138 5 9 (anh)	103	157	181-2	198	238	190	m-Toluidide, 109
10	Propane-2-sulfonamide	60, eth - pet eth	-37	bp 61°		84	134					
11	N-Ethyltoluene-4- sulfonamide	64	104-5	69	105 (dihyd), 138 5-9 (anh)	103	157	181 2	198	238	190	
12	N-Ethylbenzyl sulfon- amide	65-6, eth , Igr		92	105, w, al	102	166 (146)		113, al	102	83	
	N-(1-Naphthyl)ethane sulfonamide	66	- 17	bр 178	58	58		115				
14	Ethane-1,2-disulfon- anilide	69		di 95, eth				201 2	d at 270	270, w		Di Et ester, 77, eth, m-Tolui- dide, 230
15	N-Methyltoluene-2-sul- fonamide	74-5	57	68		136		170	203 4	218		
16 17	Heptane-1-sulfonamide 2,4,5-Trimethoxybenzene	75 76		16 130		170						
18	sulfonamide  2-Phenylethane-1-sulfon- anilide	77	91	33	122							
19	N-Methyltoluene-4- sulfonamide	78 9	104-5	69	105 (dihyd), 138 5-9 (anh)	103	157	181 2	198	238	190	
20 21	Propane-2-sulfonanilide N-(1-Naphthyl)propane-1- sulfonamide	84 84	7 5	bp 61° bp 78¹⁵	60 52	10	134		67 8			
22	N,N-Dimethyltoluene-4- sulfonamide	86–7	104-5	69	105 (dihyd), 138 5 9	103	157	181 2	198	238	190	
23	Methane sulfonamide	90	20	bp 60 <sup>21</sup>	(anh)	100 5	125 5					Phenylhydrazı- nıum salt,
24	N-(1-Naphthyl)-3-methyl- butane-1-sulfonamide	90-1		bр 98 <sup>13</sup>	3	42						193 5-4d
25	4-Chloro-3-methylbenzene sulfonanilide	92		63	128							
26	Toluene-3-sulfonanilide	96		12	108				106			

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

				Derivat	tives of the cor	responding	acıd	Salts	of the cor	respondin	ig acid	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	I-Naph- thyl amide	S- Benzyi thiu- ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
27	3-Chloro-4-methylbenzene sulfonanilide	96		38	134					}		
28	3,3-Dimethylbutane sul- fonamide	96-7		43 4			į					
29	Hexadecane-1-sulfon- amide	97	54	54	Ĭ							
30	2-Ethylbenzene sulfon- amide	100		11 7						i		
31	10-Bromocamphor-3- sulfonamide	100-2		97	į							Phenylhydrazı-
32	Methane sulfonanilide	100 5	20	bp 60 <sup>21</sup>	90	i	125 5	i				nium salt, 193 5-4d
33	N,N-Dimethylbenzyl sulfonamide	101		92-3, eth , lgr	105, w , al	102, al	166 (146)		113, al	102	83	Hydrazide, 131 2 Phenylhydra- zide, 173
34	Benzyl sulfonanilide (Toluene-α-sulfon- anilide)	102, al		92	105, w, al		166 (146)		113, al	102	83	Hydrazide, 131 2 Phenylhydra- zide, 173
35	Toluene-4-sulfonanilide	103	92 (104 5)	69	137			181 2	198	238	190	N-Xanthylsulfon amide, 197
36	4-Chlorobenzene sulfon- anilide	104	69 (93)	53	144		190	175	208 10	222 3	163 4	
37	<b>Benzyl sulfonamide</b> (Toluene-α-sulfonamide)	105, w , al		92-3, eth, lgr		102, al	166 (146)		113, al	102	83	Hydrazide, 131 2 Phenylhydra- zide, 173
38	N-(1-Naphthyl)-2-methyl- propane sulfonamide	107		bр 80 <sup>13</sup>	14-6	38		<u> </u>  -				
39 40	Toluene-3-sulfonamide 2,4-Dimethyl-6-nitro- benzene sulfonamide	108, al 108	97	12		96			106		108	
41	2,4,6-Trimethylbenzene sulfonanilide	109	78	56	142			<b>)</b>				N-Xanthylsulfor amide, 203
42	N-Methylbenzyl sulfonamide	109-10	(2/1-1)	92-3, eth, bz	105, w, al	102, al	(146)		113, al	102	83	N-Xanthylsulfon amide, 188, Hy- drazide, 131 2, Phenylhydra- zide, 173
	2,4-Dimethylbenzene sulfonanilide	110	62 (hyd )	34								   N-Xanthylsulfon
44	4-Ethylbenzene sulfon- amide 3-Hydroxynaphthalene-2-			112						241 2		amide, 196
46	sulfonamide	110-1	357	Hydro- chlo- ride,		145						Hydrazide, 94
47	Naphthalene-1-sulfon- anilide	112 (152)	90	141-4 d 68, 66	150			137	181	183	237	
48	Benzene sulfonanilide	112	66 (anh )	14 5	156		170 1	148	205	240	176	N-Xanthylsulfon amide, 200
49	3-Methoxynaphthalene-2-sulfonamide	113	00	138		174						,
	2,6-Dimethylbenzene sulfonamide	113 (96)	98	39								2-N-p-Toluene-
51	2-(N-Methylamino)ben- zene sulfonamide	114555	182 d									sulfonyl deriv o sulfonamide, 19

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

_				Deriva	tives of the co	rresponding	acıd	Salts	of the cor	respondin	g acıd	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	1-Naph- thyl amide	S Benzyl thiu- ronium	p-Tolut- dinium	Anı- lınıum	o-Tolui dinium	Miscellaneous derivatives of the acid
52	2-Nitrobenzene sulfon- anilide	115	70 (85)	69	193							
53	N-Benzyltoluene-4- sulfonamide	115 6	92	69	137		į	181-2	198	238	190	N-Xanthylsulfon- amide, 197
54	8-Methylnaphthalene-2- sulfonamide	116		88		1						
55	Indane-4-sulfonamide	118 9, w		53-3 5, b p 140-14							! !	
56	4-Bromobenzene sulfon- anilide	119	88 90	76, eth	166, 161		183 5	170	215 6	237 8	182 3	
57	3,5-Dimethylbenzene sulfonanilide	119		94 90	135				121 2 d			
58	6-Methoxynaphthalene-2- sulfonanilide	120		93	189							- -
59	D-Camphor-10-sulfon- anilide	121	193	67	132							
60	7-Methoxynaphthalene-2- sulfonanilide	121		83	220							;
61	2-Phenylethane-1- sulfonamide	122	91	33	1	77		i				
62	4-Formylbenzene sulfon- amide	122 4										Oxime, 158, O,O- Diacetate of sul- fonamide, 86- 7.5
63	5-Nitronaphthalene-1- sulfonanilide	123		113	236							Me ester, 117 8,
64	2-Methylnaphthalene-1- sulfonamide	124		83 5								
65	D-Camphor-3-sulfon- anilide	124	77	88	143				196 7			Me ester, 77, $[\alpha]_D + 9861n$ chl
66 67	Biphenyl-4-sulfonanilide 4-Fluorobenzene sulfon- amıde	125 125		115 36 30	230							
68	N-(1-Naphthyl)methane sulfonamide	125 5	20	bp 6021	90	100 5						
69	3-Nitrobenzene sulfon- anilide	126	48	64	167		166 5	146	222	222	193	
70	Phenol-O-sulfonanilide	126 5 7 5	145 (mono- hyd)						124 5	126 5 7 5		
71	5-Aminonaphthalene-2- sulfonanilide	127 8			219			191				5-N-Acetyl deriv of sulfonamide, 247
73	4-Chloro-3-methylbenzene sulfonamide	128		63		92						Sulfonyl bromide, 67 5
74	6-Fluoronaphthalene-2- sulfonanilide	129	105 (hyd)	97	133							
75	5-Ethoxynaphthalene-1- sulfonanilide	130		121	182 5						į	
76	3-Chloro-4-methoxyben- zene sulfonamide	131		82								
77	4-Aminonaphthalene-2- sulfonamide	131 (hyd )										4-N-Acetyl deriv of sulfonamide, 220
78	2,5-Dimethyl-4-nitro- benzene sulfonanilide	131	140	75	197-8				143 5 4 5		143 5 4 5	<i>22</i> · · · · · · · · · · · · · · · · · ·

<sup>\*</sup>Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)\* (Continued)

				Derivat	tives of the co	responding	acıd	Salts	of the cor	respondin	g acid	T
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	l Naph thyl- amide	S Benzyl thiu conium	p-Tolui- dinium	Anı- Jinium	o-Tolui dinium	Miscellaneous derivatives of the acid
79	3-Ethoxybenzene sulfon-	131		38								
80	amide D-Camphor-10-sulfon- amide	132	193	67		121 (88)						
81	Naphthalene-2-sulfon- anilide	132	91 (hyg )	76 79	217 _13	}						
82	6-Fluoronaphthalene-2- sulfonamide	133	105 (hyd )	97, chl		129		190 1	221	269	213	
83	DL-Camphor-8-sulfon- amide	133 5 w	56 8	106								
84	3-Methyl-4-nitrobenzene sulfonamide	133 5		50	į					}		
	3-Chloro-4-methylbenzene sulfonamide			38		96				!		
	N-(1-Naphthyl)propane- 2-sulfonamide	134	- 37	bp 61°	60	84			121.2		}	m-Toluidide, 109
87	3,5-Dimethylbenzene sulfonamide Tetraline-6-sulfonamide	135, al		94, 90, bz 58		129, al			121 2 al			
89	Indane-5-sulfonamide	135 5 6, al	92	46-7, eth b p		129, al						
90	Toluene-2-sulfonanilide	136	57	148 9 <sup>4</sup> 68	156			170	203 4	218		N-Xanthylsulfon- amide, 183
91	4-lodonaphthalene-1- sulfonanilide	136		124 121	206 204							amide, 183
92	D-Camphor-8- sulfonamide	137		138		ĺ						$[\alpha]_{b}^{3} + 93.6$ ,
93	4-Chloro-2-nitrobenzene sulfonanilide	138	82	75	237	ļ						
94	2,4-Dimethylbenzene sulfonamide	138	62 (hyd )	34		110		146				N-Xanthylsulfon- amide, 188
95	Toluene-4-sulfonamide	138 5 9 0 (anh.) 105 (dihvd.)	104 5	69		103	157	181 2	198	238	190	N-Xanthylsulfon- amide, 197
96	8-Aminonaphthalene-1- sulfonanilide	139 40						300				
	sulfonamide	139 40							182 3			Dimethylamide, 62 3
98	2-Bromonaphthalene-1- sulfonamide	140		97								
	3,4-Dichlorobenzene sulfonamide	140, 135	70	22 4, 19		100		,				NI W. al. 1 10
100	2,4,6-Trimethylbenzene sulfonamide 7-Ethoxynaphthalene-2-	142	78	103		109						N-Xanthylsulfon- amide, 203
	sulfonamide 3-Aminobenzene	142		103		100		148				
102	sulfonamide 3,5-Dimethyl-2-hydroxy-	142 3	121 5					170				2-O-Acetyl deriv
.03	benzene sulfonanilide		5									of sulfonyl chlo- ride, 62, pet eth
104	D-Camphor-3- sulfonamide	143	77	88		124			196 7			N-Methylanilide, 111 2, Me ester, 77, $\{\alpha\}_D$ +98 6
105	5-Chloro-2-methylben- zene sulfonamide	143	21, 24									ın chl

<sup>\*</sup>Derivative data given in order im pi, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)\* (Continued)

				Deriva	tives of the coi	responding	acıd	Salt	s of the co	rrespondi	ng acid	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	l Naph- thyl- amide	S Benzyl thiu ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
106	4-lodobenzene sulfonanilide	143		85	183							
107	2,5-Dimethyl-3-nitro- benzene sulfonanilide	143 4	128 (200)	61	173				135-6		126 5- 7 5	
108		143 4		124 5								
109	Benzophenone-2- sulfonanilide	143 5		96 7							ĺ	
110	4-Ethoxynaphthalene-2- sulfonanilide	143 5		85	183	ļ						
111	sulfonamide	144	64 (55)	52	i			208				
112	sulfonanilide	144	100 (hyd )	86	206							Et ester, 93
113	sulfonamide	144	69 (93)	53		104	190	175	208-10	222 3	163 4	
	4-Methyl-3-nitrobenzene sulfonamide	144 5	92 (hyg )	36		109	153		130 1		28	
116	3-Chloro-6-methylben- zene sulfonamide Pyridine-3-sulfonanilide	145, aq al		24	110 1							•
117		145	195 6 (anh)	136 7								
118		145 6	130 3	94 5	187		162			145 6	151	Me ester, 83 Et ester, 104
119	4-Bromo-3-methylben- zene sulfonamide	146		50								·
120	4-Methoxy-3-nitroben- zene sulfonamide	146 3		66								
121	1-Aminonaphthalene-7- sulfonanilide	147		i	181 (hyd )							Benzoylguanıdıne salt, 214 6
	4-Methoxynaphthalene-2- sulfonanilide	147 5		98 5	226							
	3-Chlorobenzene sulfon- amide	148		46.7	106				199- 200	206 7	254.0	
	2-Methyl-5-nitrobenzene sulfonanilide	148	133 5	46-7	186			104	256 7		256 8	N1 37 - 41 - 1 - 10
	2,5-Dimethylbenzene sulfonamide	148	48 (anhyd ) 86 (hyd )	24 6	229		245	184				N-Xanthylsulfon- amide, 176 N-Xanthylsulfon-
126	Benzene-1,3-disulfon- anilide 6-Methoxynaphthalene-1-	148 50	i	63 80 5	229	177 5	243	214				amide, 170
128	sulfonamide	150	90	68, 66		1112		137	181	183	237	
	amide 4-Ethoxybenzene sulfon-	150		39		(152)		/-			-	
130	amide 4,6-Dichloro-2,5- dimethylbenzene sulfon-	150		81		175						
131	amide 3-Bromo-4-methylben-	151		60				÷		ĺ		
132	zene sulfonamide  2-Hydroxynaphthalene-	152-5		tri 196								
133	3,6,8-trisulfonanilide 7-Ethoxynaphthalene-2- sulfonanilide	153		103	142							
134	Į	153		75								

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)\* (Continued)

				Derivat	ives of the cor	responding	acid	Salts	of the com	responding	g acıd	
ło	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anılıde	I-Naph thyl amide	S Benzyl thru ronium	p Tolui dinium	Anz linium	o Tolui dinium	Miscellaneous derivatives of the acid
35	8-Chloro-7-methoxynaph- thalene-1-sulfonamide	153		137		196						
36	2-A minobenzene sulfon- amide	153						132				2-N Benzoyl deriv of sulfonamide 198, Hydro chloride, 201
137	5-Methylbenzene-1,3- disulfonanilide	153, al		94, eth	216, w							emoride, 201
38	6-Ethoxynaphthalene-2- sulfonanilide	153		107 5	183			İ				
39	2-Iodonaphthalene-1- sulfonamide	154		110								
40	6-Ethoxynaphthalene-1- sulfonamide	154		118		194 5						
41	2,6-Dichloro-4-methyl- benzene sulfonamide	154-5		56								
	4-Chloro-2,5-dimethyl- benzene sulfonanılide	155	100	50	185				]			
43	4-Amino-2-hydroxyben- zene sulfonamide	155		169								
44 45	Tetraline-6-sulfonanilide Benzene sulfonamide	155 6 156 (153)	43 4 (mono- hyd), 66 (anh)	58 14 5	135		170 1	148	205	240	176	N Xanthylsulfon amide, 200
46	2-Chloro-5-methylbenzene sulfonamide	156	(4)	56		229- 30 5					<u> </u>	
47	D-3-Bromocamphor-10- sulfonamide	156	47 5	65				}				
48	Toluene-2-sulfonamide	156 3	57	68		136		170	203 4	218	<u> </u>	N Xanthylsulfon amide, 182-3,5
	4-Methoxynaphthalene-2- sulfonamide	157		75 5	145				į		į	f
	sulfonanilide	157		119 5	194 5							
51	N-(1-Naphthyl)toluene-4- sulfonamide	157	104-5	69	(dihyd ), 138 5 9 (anh )	103		181 2	198	238	190	
52	Benzophenone-3,3'-disul- fonamide	157		di 137-8		dı 177 8						N-Xanthylsulfon amide, 197
53	2,4-Dinitrobenzene sulfon- amide	157, 154	106 8 (hyd), 130 (anh)	102					į			Hydrazide 110
54	2-Methyl-4-nitrobenzene sulfonamide	157		106								į
55	2-Nitrodiphenylamine-4- sulfonanilide	157	220d		162							
56	Phenanthrene-2-sulfon- anilide	157 8	150	156	253-4				291			Me ester, 101 2, Et ester, 89, yel-br
57	4-Methylnaphthalene-1- sulfonanilide	158		81	174, 177							, , , , ,
58	2-Ethoxynaphthalene-1- sulfonamide	158		116		187						
59		158		81	177							

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

				Derivat	ives of the cor	responding	acıd	Salts	of the cor	respondin	g acid	
No	Name	Melting point °C	Sulfonic acid	Chloride	Amide	Anilide	1 Naph- thyl amide	S Benzyl thiu ronium	p-Tolui- dinium	Anı lınıum	o-Tolui dinium	Miscellaneous derivatives of the acid
160	2-Ethoxybenzene sulfon- anilide	158		65 6	163							Phenylhydrazide,
161	2-Methoxynaphthalene-1- sulfonamide	159		121		196 5						132 3
162	3-Nitrobenzylsulfonamide (3-Nitrotoluene-α-sulfonamide)	159d , w	74 (hyd )	100 bz								Me amide, 106 7 Dimethyl- amide, 118 9
163	5-Amino-2-hydroxyben- zene sulfonanilide	159 (98)	100 (anh )		202 d				į			
164	5-Chloro-2-nitrobenzene sulfonamide	159		93								
165	2,5-Dichlorobenzene sul- fonanilide	160	93 7	38	181			170				
166	3,5-Dimethyl-2-hydroxy- benzene-1,4-disulfon- amide	160 1		di 89 91						! !		
167	6-Hydroxynaphthalene-2- sulfonanilide	161	129 (hyd ) 167 (anhyd )		238	 		217 (207)	247	264	208	
168	2-Methylbenzene-1,3- disulfonanilide	162	(4, 4 )	88	260							
169	N-(1-Naphthyl)-4-chloro- naphthalene-1-sulfon- amide	162	130 3	94 5	187	145 6				145 6	151	Me ester, 83 Et ester, 104
170	2-Nitrodiphenylamine-4- sulfonamide	162	220 d			157						
171		162 4		96	197	 						
172	2-Ethoxybenzene sulfon- amide	163		65 6		158	1	 				Phenylhydrazide, 132-3
173	7-Methylnaphthalene-2- sulfonamide	163 4		63 4							,	
174	3-Methyl-2-nitrobenzene sulfonamide	163 5		58 5					ļ			
175	5-Amino-2-methylbenzene sulfonamide	164				146 7	ĺ			}		5-N-Acetyl deriv of sulfonamide, 242
176	4-Chloro-2-nitrobenzene sulfonamide	164		75		138						Phenylhydrazide, 151, Ph ester, 82
177	4-Nitrodiphenylamine-2- sulfonanilide	164		102 4	174			1				
178	4-Aminobenzene sulfon- amide	165				200	196	185				
179	3,6-Dichloro-2,5-di- methylbenzene sulfon- amide	165		71	<u> </u>	171						
180	6-Aminonaphthalene-1- sulfonamide	165						172 4				Benzoylguanidine salt, 210 1
181	N-(1-Naphthyl)benzyl sulfonamide	166 (146)		92 3, eth , bz	105, w , al	102, al			113, al	102	83	Hydrazide, 131 2, Phenyl- hydrazide, 173
182	4-Bromobenzene sulfon- amide	166, 161	88-90	76, eth		119	183 5	170	215-6	237-8	182-3	nyarazido, 173
183	5-Bromo-2-methylbenzene sulfonamide	166 7		33-5								
184	N-(1-Naphthyl)-3-nitro- benzene sulfonamide	166 5	48	64	167	126		146	222	126 5- 7 5	193	
185	3-Nitrobenzene sulfon- amide	167	48	64		126	166 5	146	222		193	

<sup>\*</sup>Derivative data given in order m.p. crystal color, solvent from which crystallized

				Deriva	tives of the co	rresponding	acıd	Salts	of the corr	respondin	g acıd	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	l Naph- thyl- amide	S- Benzyl thiu- ronium	p-Tolus- dinium	Anı- lınıum	o Tolui- dinium	Miscellaneous derivatives of the acid
186	2,4-Dimethoxybenzene sulfonamide	167		70								
187	ì	167		60						į		
188	4-Hydroxynaphthalene-1- sulfonamide	167				199-200						
189	sulfonamide	167		47								
190	benzene sulfonamide	168		43							-	F
191	4-Chloronaphthalene-2- sulfonamide	168		106								Et ester, 76 9
	4,5-Dibenzylnaphthalene- 1-sulfonamide 4-Bromo-2-methylbenzene			151								
194	sulfonamide	169, w	92 d	di 45	1	di 125						Dı- <i>m</i> -toluıdıde,
ا	amide	1.40 ==										222, Di- hydrazide, 105
	Propane-1,1-disulfon- amide 2,4,5-Trimethoxybenzene	169 70 170		130	76	151-2, al						
	sulfonanilide 4-Acetamidonaphthalene-	170		130	241							
	1-sulfonanilide 4-Ethoxynaphthalene-1-	170		103		180						
199	•	dı 170	98 (hyd ),	di 20				163	224-6			
200	amide 4-Methyl-2-nitrobenzene sulfonamide	170	148 (anh )	98 9								o-Anisidide, 13.
201		170-1	43-4 (mono- hyd), 66 (anh)	14 5	156	112		148	205	240	176	Me ester, b p 150 <sup>15</sup> , N-Xan- thylsulfon- amide, 200
202	3,6-Dichloro-2,5-di- methylbenzene sulfon- anilide	171		71	165							
203	5-Aminonaphthalene-1- sulfonanilide	171			260			179				
204	anilide	171 (136)	109 11 (95)	80, lgr	180				179-80			
	zene sulfonamide	172	144 (anh )	96								
	8-Nitronaphthalene-2- sulfonanilide	172-3	135 6 (hyd )		223	143 4			126			
207 208	2,5-Dimethyl-3-nitroben- zene sulfonamide 4-Nitrodiphenylamine-2-	173	128 (200)	102 4		143 4			136			
209	sulfonamide 7-Ethoxy-8-nitro-	173 4		155		104						
	naphthalene-1-sulfon- amide	-										
	2,5-Dimethylbenzene-1,3- disulfonanilide	174, al		81, lgr	295, al	1						
211	3-Methoxynaphthalene-2- sulfonanilide	174	11.5	138	113	1						
212	3,4-Dibromobenzene sul- fonamide	175	66 5-7 5 (anhyd)	34								

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

			1	Derivat	ives of the cor	responding	acıd	Salts	of the cor	espondin	g acid	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Amilde	I-Naph- thyl- amide	S- Benzyl thiu- ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
213	methylbenzene sulfon-	175		81	150							
214	anilide 4-Chloro-3-nitrobenzene sulfonamide	175 6, yel ,		40 1 (60 2)								
215	7-Chloronaphthalene-2- sulfonamide	176	68 (tetra- hyd ) 118 (anhyd )	87								Me ester, 89, Et ester, 65
216	3-Amino-4-methylbenzene sulfonamide	176										3-N-Benzoyl deriv of sulfon- amide, 203, 3-N- Acetyl deriv of sulfonyl chlo- ride, 144, 3-N- Benzoyl deriv of sulfonyl chlo- ride, 196
217	4-Bromo-3-nitrobenzene sulfonamide	176-7		55 7		-						1140, 170
218		176 7		141				169	202	170	192	
219	5-Methylnaphthalene-1- sulfonamide	176 8	115									
220	4-Methylnaphthalene-1- sulfonamide	177 d 174		81, lgr		158						
221	2-Chloro-5-methyl-6- nitrobenzene sulfonamide	177		122							ļ	
222	Benzophenone-3,3 -disul- fonantiide	177 8		di 137 8	di 157	ļ						
223	6-Methoxynaphthalene-1- sulfonanilide	177 5		80 5	149 5							
224	A cenaphthene-5-sulfon- anilide	178		111	223							
225	2-Methylbenzene-1,4-di- sulfonanilide	di 178		98	224				ļ			
226	8-Nitronaphthalene-1- sulfonanilide	178 8 5	115 (trihyd)	165 d	190 5 1 5				Ì			
227	Naphthalene-1,4-disulfon- anilide	179			273, w , al				<u> </u>			
228	4-Nitrobenzene sulfon- amide	180, 50°, al	109 11 (95) (hyg)	80, lgr		171 (136) d			179 80			
229	4-Ethoxynaphthalene-1- sulfonanilide	180		103	170							
230	3,4-Dimethyl-5-nitroben- zene sulfonamide	180		70								
231	3-Chloro-2-methylbenzene sulfonamide	180 w	60-72	72, pet eth								
232	2-Aminonaphthalene-8- sulfonamide	181 (hyd )				147						1-N-Acetyl deriv of sulfonamide, 213, Benzoyl- guanidine salt,
233	2,5-Dichlorobenzene sul-	181	93 7	38		160	160	170	247-8	262-3	250-1	214-6
234	fonamide 2,4,5-Trimethylbenzene sulfonamide	181	(>1 00) 112	61								

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)\* (Continued)

				Derivat	ives of the cor	responding	acid	Salts	of the cor	espondin	g acıd	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	1-Naph thyl- amide	S- Benzyl thiu ronium	p-Tolui- dinium	Anı- lınıum	o Tolui dinium	Miscellaneous derivatives of the acid
235	5-Chloro-4-methyl-2- nitrobenzene sulfon- amide	181	128	99								
236	2,4-Dichlorobenzene sulfonamide	182	86	55					204 6		170 2	
237	2,5-Dimethyl-6-nitroben- zene sulfonanilide	182	145 (anh )	110	192				158 5 9, al		143 5, 50°, al	
238	5-Ethoxynaphthalene-1- sulfonamide	182 5		121	1	130		ĺ				
239	6-Ethoxynaphthalene-2- sulfonamide	183		107 5		153						
240	4-Iodobenzene sulfon- amide	183		85	Į.	143						
241	4-Ethoxynaphthalene-2- sulfonamide	183		85		143 5						
242	Quinoline-8-sulfonamide	183-4	312	124								Me ester, 96, Et ester, 73, Picrate
243	4,5-Dichloro-3-methyl-	183-5		85 8								of Na salt, 226–7
244	benzene sulfonamide N-(1-Naphthyl)-4-bromo- benzene sulfonamide	183 5	88 90	76, eth	166 161	119		170	215 6	237-8	182 3	
245	6-Chloronaphthalene-2- sulfonamide	184	}	110 5					<b>!</b>			
246	5-Nitronaphthalene-2- sulfonamide	184	118 9, yel	125						260 d		
247	8-Chloronaphthalene-2- sulfonamide	185	1	94								
	4-Chloro-2-methylbenzene sulfonamide			54								
	4-Chloro-2,5-dimethyl- benzene sulfonamide	185	100	50		155						
250	2-Carboxy-5-methylben- zene sulfonamide (4- Toluic acid-2-sulfon- amide)	185	190 (158) (anh)	di 59								
251	2-Chloro-5-nitrobenzene sulfonamide	185-6	168-9 d (hyd)	90, w								
252	2-Bromobenzene sulfon- amide	186, w		51, eth								
	3,5-Dichloro-2-methyl- benzene sulfonamide	186		54					i			
254	2-Methyl-5-nitrobenzene sulfonamide	186	133 5 (dihyd)	46-7, b p 183-5 <sup>10</sup>		148			256–7		256-8	
255	2-Chloro-4-methyl- benzene sulfonamide	186		46, 52								
256	4-Methylbenzene-1,3-di- sulfonamide (Toluene- 2,4-disulfonamide)	186-7 (191)		54, 46		189		,	277 d	dı 189	di 170-1	Di-m-toluidide, 138
257	2-Ethoxynaphthalene-I- sulfonantiide	187		116	158							
258		187	130 3 d	94-5		145-6	162			145-6	151	Me ester, 83, Et ester, 104
259	8-Iodonaphthalene-1- sulfonamide	187	115	140								

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

				Derivat	ives of the coi	responding	acıd	Salts	of the cor	espondin	g acıd	
No	Name	Melling point, °C	Sulfonic acid	Chloride	Amide	Anihde	l Naph- thyl amide	S- Benzyl thiu ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
260	2,4-Dimethyl-5-nitro- benzene sulfonamide	187 (179)	132 (122) dil HNO <sub>3</sub>	98								Sulfonyl chloride, 109-10
261	2,4-Diaminobenzene-1,5- disulfonamide	187	11103	275		236		İ	}	}	ì	
262	8-Bromonaphthalene-2- sulfonamide	187		121			i		i			
263	2-Chlorobenzene sulfon- amide	188		28 5					ļ			
264	4-Nitronaphthalene-1- sulfonamide	188		99		)						
265	2,6-Dichloro-3-methyl- benzene sulfonamide	188		19 5		1	}		 			
	5-Methylnaphthalene-2- sulfonamide	188 9		120 2		248 50 (133 4)						
	4-Methylbenzene-1,3- disulfonanilide	189		54, 46	186-7	120						
	6-Methoxynaphthalene-2- sulfonamide	189		93		120						4-N-Acetyl deriv
269	Sulfanilylguanidine (Sulfaguanidine)	189 90 (anh), 143 (hyd)										of sulfonamide, 262 6 (248 51) Hydrochloride, 205 6
270	N-(1-Naphthyl)-4-chloro- benzene sulfonamide	190	69 (93)	53	144	104		175	208-10	222 3	163 4	203 6
271	2,4-Dibromobenzene sulfonamide	190	110 (anh )	79, eth								
272	4-Methylbenzene-1,2- disulfonanilide (Toluene-	190		109 11	237 9		ļ					
273	3,4-disulfonanilide) Phenanthrene-3-sulfon- amide	190	175-6 (anh), 120-1 (mono- hyd) 88 d (dihyd)	110 1				222				Me ester, 119 20, al Et ester, 107-8
274	4-Aminonaphthalene-1- sulfonanilide	190										4-N-Acetyl deriv of sulfonamide, 247
275	8-Nitronaphthalene-1- sulfonamide	191	115 d (trihyd)	165 d		178-8 5						
276		191	(, - /	di 111								
277	3,5-Dichloro-4-methyl- benzene sulfonamide	191		69								
278		191-2									]	4-N-Acetyl deriv of sulfonamide, 226 7, acet
279	Anthraquinone-2,7-disul- fonanilide	192		di 186 chl								
280	4-Carboxy-3-nitrobenzene sulfonamide (2-Nitrobenzoic acid-4-sulfonamide)	192	$H_2O$	di 160								Diamide, 226
281 282	Quinoline-6-sulfonamide	192 192	>260	91 167	<u> </u>							

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

				Derivat	ives of the coi	responding	acıd	Salts	of the cori	g acıd		
No	Name	Melting point, *C	Sulfonic acid	Chloride	Amide	Anilide	I-Naph- thyl amide	S Benzyl thtu rontum	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
283	•	192		186								
284	fonamide 2,5-Dimethyl-6-nitro- benzene sulfonamide	192	145 (anh )	110		182			158 5		143 5, 50°, al	
285	2-Amino-5-methylben- zene-1,3-disulfonanilide	192		156	257						"	
286	Methane disulfonanilide	192 3	220 715 d	8 b p 13310	dı 233							
287	3,4-Dicarboxybenzene sulfonamide (Phthalic acid-4 sulfonamide)	192 200 d w	138 40 (mono- hyd)	167 70 d eth								
288	2-Nitrobenzene sulfon- amide	193	70 (85)	69		115						
289	Anthraquinone-2-sulfon- anilide	193		197	261			211	308	309		Me ester, 123 Et ester, 125
290	Phenanthrene-9-sulfon- amide	193 4	174 (anh )	127					235			Me ester, 106, me al Et ester, 108, al
291	2-Carboxybenzene sul- fonantlide	194 5	68 9 (hyd.) 134 (anh.)	79, pet eth	<u> </u>			206	196 (200)	165	127 8	
292		194 5	137 (21111 )	119 5	}	157	1	<u> </u>  -	(=00)		}	
293		194 5		118	154							
294	7-Hydroxynaphthalene-	195		161 2				228	294		271	
295		195		87								
296	7-Hydroxynaphthalene-1- sulfonanilide	195						218	232	240	242	
297	2,5-Dibromobenzene sul- fonamide	195	128 (anh )	71	<u> </u> 	}	}		:	i	ļ	
298	7-Methylnaphthalene-1- sulfonamide	195 6		96		162 4					İ	
299	4,6-Dimethylbenzene-1,3-disulfonanilide	196, 50°, al	İ	130, pet eth	249, w	İ		İ				
300	4,7-Dichloronaphthalene- 2-sulfonamide	196		156								
301	N-(1-Naphthyl)-4-amino- benzene sulfonamide	196			165	200		185				
302	8-Chloro-7-methoxy- naphthalene-1-sulfon- anilide	196		137	153						İ	
303		196 7	105 (hyd )	122 3								Me ester, 118, eth
304	2-Methoxynaphthalene-1- sulfonanilide	196 5		121	159							
305	8-Chloronaphthalene-1- sulfonamide	197		101								
306	4,5-Dichloronaphthalene- 2-sulfonamide	197		158								
307	2,5-Dimethyl-4-nitro- benzene sulfonamide	197 8	140	75		131			143 5 4 5		143 5 4 5	i

<sup>\*</sup>Derivative data given in order m p crystal color, solvent from which crystallized

_	T			Deriva	tives of the co	rresponding	acıd	Salts	of the cor	respondin	g acıd	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	I-Naph- thyl- amide	S- Benzyl thiu ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
308	Sulfamethazine (Sulfadi- methylpyrimidine)	198 9 (+½ H <sub>2</sub> O),										4-N-Acetyl deriv of sulfonamide, 249 50
309	Acenaphthene-3-sulfon- amide	pa yel 199	87 9	113 4		284 6	 				i i	Me ester, 122 3, Et ester, 137 9,
310	4-Hydroxynaphthalene-1- sulfonanilide	199 200	170		167			103	196	186-7	203 4	2-Naphthyl sul- fonamide, 204
311	4-Aminobenzene sulfon- anilide	200	į		165		196	185	109		132	4-N-Acetyl deriv of sulfonantlide, 214, Me ester, 92
312	4,5-Dimethylbenzene-1,3-disulfonanilide	200, al		79, yel	239							,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
313	· ·	201		52								
314		201		122	261							Phenylhydrazide, 210, Me ester, 157, Et ester,
315	5-Hydroxynaphthalene-1- sulfonanilide	201	110 2 d									160 O-Acetyl deriv of sulfonyl chloride, 129
316	2-Hydroxynaphthalene- 3,6-disulfonanilide	202						233	250	254	257	,
317		202 d	100 (anh )			159 (98)						
318		202	105, grn	121, bz - pet eth	214							
319	Sulfathiazole	202 5										4-N-Acetyl deriv of sulfonamide, 256 7
320	4-Nitrobenzył sulfonamide (4-Nitrotoluene-α- sulfonamide)	204	71	90	220 d							
321	Anthracene-1-sulfon- amide	205		90								
322	4,8-Dichloronaphthalene- 2-sulfonamide	205		141				i				
Ì	3-Amino-4-hydroxyben- zene sulfonamide	205 (170)	155-6 d									
324	4-Hydroxybenzene-1,3-di- sulfonanilide (Phenol- 2,4-disulfonanilide)	205	> 100 d	89	239							
325		205-6		97 8								
326		205-7		117-8	206-8					į		
327	4-Iodonaphthalene-1- sulfonamide	206, 204		124, 121		136						
328	4-Fluoronaphthalene-1- sulfonamide	206	100 (hyd )	86		144						Et ester, 93
330	4-Amino-3-nitrobenzene sulfonamide	206 7		59-60								

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

			T	Deriva	tives of the co	rresponding	acıd	Salts	of the cor	respondin	g acıd	
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anslide	I-Naph thyl- amide	S Benzyl thiu ronium	p-Tolus- dinium	Anı- lınıum	o-Tolur- dinium	Miscellaneous derivatives of the acid
331	Retene-6-sulfonamide	206 7 5	121 3	146 7 5,								Me ester, 117 9, Et ester, 114-5
332	2,6-Dimethyl-4-hydroxy- benzene-1,3-disulfon- amide	206 8		yel -br 117-8		205 7						Et ester, 114-3
333		207		105 7								
334	6-Bromonaphthalene-2- sulfonamide	207		124								
	7-Bromonaphthalene-1- sulfonamide	209		147								
	4-Methoxybenzene-1,3- disulfonantlide	209		86	240							
	7-Iodonaphthalene-2- sulfonamide	210		100								
338	4-(N-Methylamino)ben- zene sulfonamide	210 11	244 5 d							}		p-Toluenesul- fonate, benzi- dine salt, 255
339	2,4,6-Trichlorobenzene sulfonamide	210-2 d		35 40								
340	4-Aminonaphthalene-1- sulfonamide	212				190						
341	6-Iodonaphthalene-1- sulfonamide	213		92 5								
342 343	1	213 d 214	155 (hyd ) 218	164 216-8, yel, PhNO <sub>2</sub>			ŧ	191		284		NH <sub>3</sub> → 1-Amino- anthraquinone, 252 (243)
344	1-Nitronaphthalene-2- sulfonamide	214	105, grn -	pink, bz-pet		202					]   	
345	4-Acetamidobenzene sulfonanilide	214		149	219		215		}			
346	6-Chloronaphthalene-1- sulfonamide	214		70				1				Et ester, 114-5
347	N-(1-Naphthyl)-4- acetamidobenzene sul- fonamide	215		149	219	214	<del>,</del>			<u> </u>		
	disulfonamide	215 7		114								
	disulfonamide	216, w		94, eth	ļ	153, al						
	sulfonamide	216		115								
351	amide	217, 213	91 (hyg ), (122)	76, 79		132		190 1	221	269	213	
	1-sulfonamide	217		151	ł		ļ					
	6-Bromonaphthalene-1- sulfonamide	217 218		136								
	4,6-Dichloronaphthalene- 2-sulfonamide 7-Bromonaphthalene-2-	218		136	}						[   	
	sulfonamide	218		166					!			
	2-sulfonamide									_		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

				Derivat	tives of the cor	responding	acıd	Salts	of the corr	espondin	g acıd	
10	Name	Melting point °C	Sulfonic acid	Chloride	Amide	Anılıde	l Naph- thyl amide	S- Benzyl thiu ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
157	6-Ethoxy-1-nitro- naphthalene-2-sulfon- amide	218		146								
358		218 9 d				127 8			·			1-N-Acetyl deriv of sulfonamide, 238 9
59	4-Acetamidobenzene sulfonamide	219	:	149		214	215					230 9
60	5-Bromonaphthalene-2- sulfonamide	220		96								1
61	4-Nitrobenzyl sulfon- anilide (4-Nitrotoluene- α-sulfonanilide)	220 d	71	90	204							
,62	7-Methoxynaphthalene-2- sulfonamide	220		83		121						
163	2,4,6-Tribromobenzene sulfonanilide	220 2 d	64	64	228							
364	7,8-Dichloronaphthalene- 1-sulfonamide	221		138								
365	8-Hydroxynaphthalene-1- sulfonamide		107 (hyg )									
366	sulfonamide	222		140								
367	dısulfonanilide	223		164	310							
368	5,6-Dichloronaphthalene-	223		106		170						
369 370	Acenaphthene-5-sulfon- amide 6-Nitronaphthalene-1-	223		111		178						
370	sulfonamide  2-Methylbenzene-1,4-	224		98	l	dı 178						
372	disulfonamide	224		106		un 170						
373	disulfonamide	224		225	333							
374	anilide	225		139 5								
375	sulfonamide 4,6-Dichloronaphthalene-	226		119								
376	1-sulfonamide 4-Carboxamido-3-nitro- benzene sulfonamide (2-Nitrobenzamide-	226	111 (+2 5 H₂O)	dı 160	192							
377	4-sulfonamide) 5-Chloronaphthalene-1- sulfonamide	226		95		138						Sulfonyl bromide, 110, Me ester,
378	4-Methoxynaphthalene-1- sulfonamide	226		98 5		147 5						89, Et ester, 46
379	3,4-Di-iodobenzene sulfonamide	227, aq al	122 5	82, bz - pet eth								
380	7,8-Dichloronaphthalene- 2-sulfonamide	227		124								
381	Anthraquinone-1,6-disul- fonanilide	227 8, yel	215 7, gold	197-8, yel,			İ					
382	2,3,4-Trichlorobenzene sulfonamide	227-30		PhNO <sub>2</sub> 64 5								

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

				Derivat	tives of the cor	rresponding	acıd	Salts	of the cor	espondin	g acıd	
Νo	Name	Mehing point, °C	Sulfonic acid	Chloride	Amide	Anilide	l Naph- thyl amide	S- Benzyl thiu- ronium	p-Tolui- dinium	Anı- lınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
383	3,4-Dichloro-2-methylben-	228		51 2								
384	zene sulfonamide 4'-Nitrobiphenyl-4- sulfonamide	228		178								
385	2,4,6-Tribromobenzene sulfonamide	228	64	64		220 2 d						
386	8-Nitronaphthalene-2- sulfonamide	228 223	135 6(+15 H <sub>2</sub> O)	169		172 3						
387	6,8-Dichloronaphthalene- 2-sulfonamide	228	2-/	121								
388	Benzene-1,3-disutfon- amide	229		63		148-50	245	214				N-Xanthylsulfon- amide, 170, Alk fusion → re- sorcinol, 110
389	4,5-Dichloronaphthalene-	229		117						,		SOICHOI, 110
390 391	Biphenyl-4-sulfonamide 2,4-Di-iodobenzene sulfonanilide	230 230	167 (anh )	115 77 8		125						Me ester, 78, al, Et ester, 52, al
392	2-Hydroxynaphthalene- 1,5-disulfonanilide	231		di 231				ļ ļ				
393	5-Bromonaphthalene-1- sulfonamide	232-3		95								
1	2-Hydroxynaphthalene- 1,7-disulfonanilide	233		169								
ĺ	Methane disulfonamide	233	bp 220 70 <sup>15-20</sup> d	di 8, b p		192-3				i	 	
	2-Ethoxybenzene-1,4- disulfonamide	233		di 106 8								
]	3,5-Dinitrobenzene sulfon- amide			99, chl , lgr								
398	4-Aminobenzene-1,3-di- sulfonamide (Aniline- 2,4-disulfonamide)	235, w	120 d									
399	7-Chloronaphthalene-l- sulfonamide	235		129	c   							
400	5,6,8-Trichloronaph- thalene-2-sulfonamide	235		158	ļ							
401	4,6,7,8-Tetrachloronaph- thalene-2-sulfonamide	235		176								
402	5-Nitronaphthalene-1- sulfonamide	236		113		123						<u> </u>
403	sulfonamide	236	94 (hyd ) 260 (anh )	di 57		di 252						
404	2,4-Diaminobenzene-1,5-disulfonanilide	236		275	187							
ĺ	2,3-Dichloro-4-methylben- zene sulfonamide	237	100	41	210.5							T Ut 147
406	Benzene-1,3,5-trisulfon- anilide	iri 237	> 100	tri 187	tri 310 5							Tri-Et ester, 147, bz
408	Anthraquinone-1,7-di- sulfonanilide	237-8, yel, cl bz	120 (hyd )	321-2, br -yel , PhNO,						!		
409 410	Anthraquinone-1,8-di- sulfonanilide 4-Methylbenzene-1,2-di- sulfonamide	237-8, yel, PhNO <sub>2</sub> 237 9	293-4	222 3 109-11	> 340	190				 		

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

				Deriva	tives of the co	rresponding	acid	Salts	of the cor	]		
No	Name	Melting point °C	Sulfonic acid	Chloride	Amide	Anihde	l Naph- thyl amide	S- Benzyl thiu- ronium	p-Tolui- dinium	Anı lınıum	o-Tolui dinium	Miscellaneous derivatives of the acid
111	6-Hydroxynaphthalene-2- sulfonamide	238	129 (hyd ) 167 (anh )			161		217 (207)	248	264	208	
112	4-Hydroxybenzene-1,3- disulfonamide (Phenol- 2,4-disulfonamide)	239	>100 d	89		205		(2017)				
113	· ·	239		141					ļ			
114	4,5-Dimethylbenzene-1,3- disulfonamide	239		79, yel		200, al						
115	7-Iodonaphthalene-1- sulfonamide	240		165	į							744
116	4-Methoxybenzene-1,3- disulfonamide	240		86		209		İ				
117	4-Acetamidonaphthalene- 1-sulfonamide	241				170						
	Benzene-1,2-disulfon- anilide	241		143	254			206			i	
	5-Nitrobenzene-1,3-di- sulfonamide	242		di 97 8								i i
	Naphthalene-2,7-disulfon- amide	242		158 162				212	299	251-2	238	
	2,4,6-Trimethylbenzene- 1,3-disulfonamide	244		di 125		150 1						Ė
	5,8-Dichloronaphthalene- 2-sulfonamide	244 245 d		134								
	2,3,4,6-Tetrabromoben- zene sulfonamide 6,7,8-Trichloronaph-	245 d 245		157								
25	thalene-2-sulfonamide N,N'-Di(1-naphthyl)ben-	245		63	229	148 50		214				Alk fusion → i
23	zene-1,3-disulfonamide											sorcinol, 110, N-Xanthylsul
26	Anthraquinone-1,5-di- sulfonamide	246 (350)	310 d	265-70		270 d						fonamide, 170
27	1-lodonaphthalene-2- sulfonamide	247		94								
28	9,10-Dichloroanthracene- 2-sulfonanilide	248		221	279							
30	5-Methylnaphthalene-2-	248-50		120-2	188 9							
31	sulfonanilide 4,6-Dimethylbenzene-1,3- disulfonamide	249, w		130, pet eth		196, 50% al						
32		249		131 (139)	288							
33	5,6,7-Trichloronaph- thalene-1-sulfonamide	249		131								
34	Naphthalene-1,5-disulfon- anilide	249	245 (anh )	dı 183	310 (340)			257 251d	332			D <sub>1</sub> -Me ester, 205, chl
35	1-Chloronaphthalene-2- sulfonamide	250	130 3d (anh )	84 5		171 2						,
36	Azobenzene-4,4'-disulfon- amide	250 d	169d (anh )	dı 222								Et ester, 104
37	4-Carboxanilidobenzene sulfonanilide	252	94 (hyd ), 260 (anh )	dı 57	dı 236							

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

	Γ	T		Deriva	tives of the co	rresponding	acid	Salts	of the cor	respondin	g acıd	T
No	Name	Melting point, °C	Sulfonic acid	Chloride	Amide	Anilide	1-Naph- thyl amide	S- Benzyl thiu ronium	p-Tolui- dinium	Ani-	o-Tolui dinium	Miscellaneous derivatives of the acid
438	Phenanthrene-2-sulfon- amide	253 4	150	156		157 8			291			Me ester, 101-2, Et ester, 89,
439	Benzene-1,2-disulfon- amıde	254		143		241		206				yel -br
440	2-Amino-5-methylben- zene-1,3-disulfonamide	257		156		192						
441	2-Amino-5-methylben- zene-1,4-disulfonamide	257, w	290	di 156, chl		di 196- 7, aq						
442	5-Aminonaphthalene-1- sulfonamide	260				al   171 		179				5-N-Acetyl deriv of sulfonamide, 231-2
443	2-Methylbenzene-1,3- disulfonamide	260		88		162		<u> </u>				
444	Anthracene-2-sulfonamide	261		122		201						Me ester, 157, Et ester, 160
445	Anthraquinone-2-sulfon- amide	261		197		193		211	308	309		Me ester, 123, Et ester, 125
446	7-Nitronaphthalene-1- sulfonamide	261-2		169 70								
447	6,7-Dichloronaphthalene- 1-sulfonamide	268		142								
448	3,7-Dichloronaphthalene- 1-sulfonamide	269		136								
449	Anthraquinone-2,6-disul- fonanilide	269-70	310 11 (hyd)	265 70, yel	> 350			,			1	
450	Anthraquinone-1,5-disul- fonanilide	270 d	310 d	265-70	246 (350)							
451	1-Bromonaphthalene-2- sulfonamide	271		93								
452	5,7-Dichloronaphthalene- 1-sulfonamide	272		149								
453	Naphthalene-1,4-disulfon- amide	273, w , al		160 (166)		179						
454	Azoxybenzene-3,3'-di- sulfonamide	273	126	di 138								
455	4,6-Dichlorobenzene-1,3- disulfonamide	276		123								
456	Benzidine-2,2'-disulfon- amide	278		Hydro- chlo- ride, 205	in							
457	9,10-Dichloroanthracene- 2-sulfonamide	279		221		248						
458	1,5-Dichloronaphthalene- 2-sulfonamide	282		125								
459	4-Nitronaphthalene-2,7- disulfonamide	286-7		140 1								
460	Azobenzene-3,4'-disulfon-	288		123 5								
461	Benzene-1,4-disulfon- amide	288		131 (139)		249				ĺ		
462	Naphthalene-1,3-disulfon- amide	292 3		dı 1375						Ì		
463	Anthracene-1,5-disulfon- anilide	293		dı 240	di >330							
464	2,5-Dimethylbenzene-1,3- disulfonamide	295, al		81, lgr		174, al						

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)\* (Continued)

				Derivat	ives of the coi	responding	acid	Salts	of the cor	espondin	g acıd	
No	Name	Melting point, *C	Sulfonic acid	Chloride	Amide	Anılıde	1-Naph- thyl- amide	S- Benzyl thiu ronium	<i>p</i> -Tolui- dinium	Anı- Iınıum	o-Tolui- dinium	Miscellaneous derivatives of the acid
465	Naphthalene-1,6-disulfon- amide	298	125 (anh )	129				81 (235)	314-5	298-9	323-4	
466	Naphthalene-1,7-disulfon- amide	298 300	123					` ′				
467	Biphenyl-4,4'-disulfon- amide	300	72	203				171	330 d			
468	Naphthalene-2,6-disulfon- amide	305		225				256		360		
469	Azobenzene-3,3'-disulfon- amide	305		dı 166								
470	2,5-Dimethylbenzene-1,4- disulfonamide	310		164		223						
471	Naphthalene-1,5-disulfon- amide	310 (340)	245 (anh )	183		249		257, 251 d	332			Di-Me ester, 205, chl
472	Benzene-1,3,5-trisulfon- amide	310 5	>100	tri 187		tri 237						Tri-Et ester, 147, bz
473	Anthraquinone-2,6-disul- fonanilide	321		di 250, yel, cl bz								
474	Anthracene-1,5-disulfon- amide	330		dı 240		dı 293						
475	Anthracene-1,8-disul- fonamide	333		225		224						
476	8-Cyanonaphthalene-1- sulfonamide	333-4		139		į	į					
477	Anthraquinone-1,8-disul- fonamide	> 340	293 4	222 3, yel, PhNO <sub>2</sub>		237-8, yel, PhNO <sub>2</sub>						
478	Anthraquinone-1,3-disul- fonamide	> 350	310 11 (hyd)	265 70, yel		269-70, red- yel						

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLE XXV

#### 2,4-Dinitrophenyl thioether (2,4-Dinitrophenyl sulfide).\*

RSH 
$$\xrightarrow{\text{NaOH}}$$
 RSNa + O<sub>2</sub>N  $\xrightarrow{\text{NO}_2}$  SR + NaCl

From the sodium thiolate (prepared from the thiol and sodium hydroxide) and 2,4-dinitrochlorobenzene in methanol.

For directions and examples see: Cheronis, p. 642.

From the sodium thiolate and 2,4-dinitrochlorobenzene in aqueous or absolute alcohol.

See: Linstead, p. 86; Shriner, p. 255; Vogel, p. 500; Wild, p. 91; R. W. Bost, J. O. Turner and R. D. Norton, J. Amer. Chem. Soc., 54, 1985 (1932); R. W. Bost, J. O. Turner and M. W. Conn, J. Amer. Chem. Soc., 55, 4956 (1933).

#### 2,4-Dinitrophenyl sulfone.\*

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From the thioether (prepared from the thiol and 2,4-dinitrochlorobenzene) and potassium permanganate in aqueous or glacial acetic acid.

For directions and examples see: Cheronis, p. 641; Linstead, p. 87; Vogel, p. 501; Wild, pp. 91-2.

From the thioether with hydrogen peroxide, ammonium molybdate and perchloric acid in water.

See: Cheronis, p. 642.

Hg salt.

$$2 \text{ RSH} + \text{Hg}(\text{CN})_2 \rightarrow (\text{RS})_2 \text{Hg} + 2 \text{ HCN}$$

Mercuric

From the thiol and aqueous mercuric cyanide in ethanol.

For directions and examples see: Linstead, p. 86; Wild, pp. 90-91; E. Wertheim, J. Amer. Chem. Soc., 51, 3661 (1929).

#### 3,5-Dinitrothiobenzoate.\*

RSH + 
$$\frac{NO_2}{NO_2}$$
  $\frac{NO_2}{NO_2}$   $\frac{NO_2}{NO_2}$   $\frac{NO_2}{3,5-Dinitrothiobenzoate}$ 

From the thiol, 3,5-dinitrobenzoyl chloride and pyridine.

For directions and examples see: Cheronis, p. 643; Shriner, p. 255; Vogel, p. 501; Wild, p. 92; E. Wertheim, J. Amer. Chem. Soc., 51, 3661 (1929).

#### 3-Nitrothiophthalate.\*

RSH + 
$$CO$$
  $COSR$   $COOH$   $NO_2$   $NO_2$  3-Nitrothiophthalate

From 3-Nitrophthalic anhydride and the thiol.

For directions and examples see: Wild, p. 93; E. Wertheim, J. Amer. Chem. Soc., 51, 3661 (1929).

#### \*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

#### **EXPLANATIONS AND REFERENCES TO TABLE XXV (Continued)**

S-Alkylmercaptosuccinic acid (Alkylthiosuccinic acid) \*

From the thiol and disodium maleate in ethanol

For directions and examples see J G Hendrickson and L F Hatch, J Org Chem, 25, 1747 (1960)

#### 1-Anthraguinonyl thioether

From the thioether with sodium anthraquinone-1-sulfonate and sodium hydroxide in water

For directions and examples see E E Reid, C M MacKall and G E Miller, J Amer Chem Soc, 43, 2104 (1921) W S Hoffman and E E Reid, J Amer Chem Soc, 45, 1831 (1923) L M Ellis and E E Reid, J Amer Chem Soc, 54, 1674 (1932)

Acetate

RSH + CH<sub>3</sub>COCl 
$$\rightarrow$$
 CH<sub>3</sub>COSR + HCl  
RSH + (CH<sub>3</sub>CO)<sub>2</sub>O  $\rightarrow$  CH<sub>3</sub>COSR + CH<sub>3</sub>COOH  
RSH + CH<sub>2</sub>=C=O  $\rightarrow$  CH<sub>3</sub>COSR

From the thiol with acetyl chloride, or from the thiol with acetic anhydride and aqueous sodium hydroxide, or from the thiol with ketene

For directions and examples see A Schoberl and A Wagner in Methoden der Organischen Chemie (Houben-Weyl), Vol 9 (Ed E Muller), Georg Thieme Verlag, Stuttgart, 1955, pp 753-756

Methyl thioether

From the sodium thiolate with alkyl halide

For directions and examples see E E Reid, The Chemistry of Bivalent Sulfur, Vol 2, Chemical Publishing Co, New York, 1960, p 25

Disulfide

$$2 RSH \xrightarrow{[O]} RSSR + H_2O$$

From the thiol (or thiophenol) with ferric chloride in aqueous acetic acid

For directions and examples see Linstead, p 87, Wild, p 95, T Zincke and W Frohneberg, Chem Ber, 43,840 (1910)

From the thiol with chlorine, bromine or iodine in hydrocarbon solvent

See E E Reid, The Chemistry of Bivalent Sulfur, Vol 1, Chemical Publishing Co, New York, 1958, p 124

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)
a) Liquids (Listed in order of increasing atmospheric b.p.)\*

		·	<del></del>	<del></del>	1		,	Γ	<del></del>					
No	Name	Boiling point °C	Melting point, °C	n 20 D	D <sub>4</sub> ∞	2,4-Dt nttro phenyl thio- ether	2,4-Di- nitro- phenyl sulfone	3 5 Di nitro thioben zoate	3 Nitro thio phthal ate	I-An- thra- quinonyl thio ether	Mercury salt	S Alkyl mer- capto succinic acid	Disulfide	Miscellaneous
1	Methanethiol (Methyl mercaptan)	5 96	-123		0 8599 25	127 8	189 5			221	176	133	-84 72, b p 116 8	
2	Ethanethiol (Ethyl mercaptan)	36	<u> </u>	1 4318	0 8314725	114-5	160	62	149	184	85	119 5	1	Acetyl, bp 114
3	2-Propanethiol (sec- Propyl mercaptan)	56	-130 7	1 4256	0 8142	93 5 5 0	140 5	84	145	134	63		-69 b p 176	
4	2-Methyl-2-propane- thiol (tert-Butyl	64 2	1 26	1 4230	0 7999	109 11						164	bр 200 1	Benzoyl, bp 11028
5	mercaptan)  1-Propanethiol (n- Propyl mercaptan)	67 5	-1138	1 4348	0 8047	85-6 5	127 5	52	137	151	72	118 9	-85 59 b p 195-6	
6	2-Butanethiol (sec- Butyl mercaptan)	84 5	-165 0	1 4367	0 8294	65 6 6 0	120	i.	<b>[</b>		189	135	b p 95 714	Benzoyl, bp 150 <sup>20</sup>
7	2-Methyl-1-propane- thiol (Isobutyl mercaptan)	88 72		1 4386	0 8357	74 5 5 0	105 5	63 4	136	144	95	120 9 1 4	bp 220	
8		90 67 9		1 4680	0 93044	72	105	52	<u> </u>	j i			b p 174d	<u> </u>
9	1-Butanethrol (n-Butyl mercaptan)	98 100	-119 to -115	1 44402	0 8337	66	92	49	144	112 5	86	103 7- 4 144 5	bр 226	Benzoyl, bp 160 <sup>23</sup>
	2-Pentanethiol (sec- Amyl mercaptan)	1129	-169	1 4386 <sup>25</sup>	0 8281525	90							b p 122 3 <sup>10</sup>	
11	2-Methoxyethanethiol	113		1 4488		90			İ				<u> </u>	Acetyl, bp 110 <sup>110</sup>
12	D,L-3-Methylbutane- thiol (Isoamyl mercaptan)	117 118 20		1 44118	0 83475							115 6- 6 0	bp 250	
13	1-Phenylethane-1-thiol	119 20		1 557	1 022		161						58	Acetyl, bp 123-
14	D-2-Methyl-1-butane- thiol	119 21			0 840325	78 9					60	122 3- 6	bр 122-3	$[\alpha]_{D}^{23}$ +3.21
15	2-Chloropropanethiol	125		1 4844	1 1062	76 7							b p 113- 20 <sup>20</sup>	Acetyl, bp 70-
16	2-Chloroethanethiol	125-6		1 5289	1 203	95 7							ьр 170-80	Acetyl, bp 514
	2-Ethoxyethanethiol	125 6	75.82	1 5795	0 9462	66 79 5	83	40	132	114	75	107 8	b р 150-2 <sup>15</sup>	
	1-Pentanethiol (n- Amyl mercaptan) 2-Hexanethiol (sec-	126 64	-75 83 -147 0	1 44366 1 4426 <sup>25</sup>	0 8305025	80 5	83	40	132	114	/3	107 8	bр 140-5 <sup>17</sup>	PdCl <sub>2</sub> deriv , 41
	Hexyl mercaptan) 1,2-Ethanedithiol	138 9 147, 46	-410	1 5550	1 118525	248								Dı-Me
21	(Ethylene dithio- glycol) 1-Hexanethiol (n-	7 <sup>16</sup>	-81 03	1 4490	0 8526	735 50	97			129	58	96 0- 5		eth, bp 183
	Hexyl mercaptan)	İ .	-01 03				)''		}	12)		90 0- 3		
22	2-Hydroxyethanethiol	158, 5412		1 4443	1 1143	100 2					123		28	Diacetyl, b p 98-9, Diben- zoyl, 39, S-Phenyl- urethane, 59-60, bz

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS) a)Liquids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Boiling point °C	Melting point, °C	u 50	D2º	2,4-Di- ntro- phenyl thio ether	2,4-Di- nitro- phenyl sulfone	3 5 Di nitro- thioben- zoate	3 Nitro thio phthal- ate	J-An- thra- quinonyl thio- ether	Mercury salt	S-Alkyl mer- capto succinic acid	Disulfide	Miscellaneous
23	Cyclohexanethiol (Cyclohexyl mer-	158-60		1 4933	0 9782	148	172				78	150 5- 1 5	bp 288	
24	captan) cis-3-Methyl-1-cyclo hexanethiol	165		1 464725	0 91625					i i				$[\alpha]_{541}$ -2 24
25	Thiophenol (Mercaptobenzene)	169 5, 172 5	-149	1 5888	1 0780	121	161	149	131				66 5 61	4-Nitro- thio- benzoyl, 115 7- 8, Phenyl- urethane, 128
	trans-3-Methyl-1- cyclohexanethiol 2-Thiophenethiol	171	<u> </u>	1 4663 <sup>25</sup>	1 168195	119	143					:	56	$ \begin{aligned} &\{\alpha\}_{546} \\ &+ 5 50 \\ &\text{Acetyl}, \end{aligned} $
28	1,3-Propanedithiol	166 172 9	<b>- 79 0</b>	1 5371 25	1 077525	194							bр 198 <sup>20</sup>	b p 230 2 Diben-
29	1-Heptanethiol (n- Heptyl mercaptan)	176 7	-43 4	1 449825	0 8389125	81-2	101	53	96	132	77	105 8- 6 2	b p 1646	zoyl, 56 3
30	2-Octanethiol (sec- Octyl mercaptan)	186 4	- 79 0	1 4481 25	0 83293 25							0.2	b p 161- 716	
31	2-Thiocresol (2-Toluenethiol)	194 3	15			101,98 9 5	155		,		170 3	ı		S-4-Nitro- benzoyl, 90-1
32	Phenylmethanethiol (Benzyl mercaptan)	194-5	!		1 058	130, 128 5- 9 5	182 5	120	137			189- 90, 192	74, 70	Ph eth,
33	3-Thiocresol (3-Toluenethiol)  1,4-Butanedithiol	195 4 195 6	<b>– 53</b> 9	1 526525	1 039525	100-1 5, 91	145							S-4-Nitro- benzoyl, 95-6, Ag deriv, 126-7 Diben-
35	2-Phenylethanethiol	199		1 564319	1 031818	93-4 5	133						bр	zoyl, 49 5 Acetyl,
36	I-Octanethiol (n- Octyl mercaptan)	199 1	-49 2	1 451925	0 8395625	78, 76- 7 5	98			95	71	96 1- 6	168- 80 <sup>15</sup> b p 178- 83 <sup>5</sup>	bp 134 513
37 38	2-Chlorothiophenol 2,5-Dimethylthiophenol (p-Xylene-2-thiol)	205 211-2			1 2752195	138							90	S-Ph eth, bp 1725'', S-4-Tolyl, eth, bp
39	2,4-Dimethylthiophenol (m-Xylene-4-thiol)	214												188" S-Ph eth, b p 171", S-Benzyl eth, 35

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

## TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS) a)Liquids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n™	D₹	2,4-Di- nitro- phenyl thio ether	2,4-Di- nitro- phenyl sulfone	3.5 Di nitro thioben zoate	3 Nitro- thio phthal- ate	I-An- thra- quinonyl thio ether	Mercury salt	S-Alkyl mer- capto- succinic acid	Disulfide	Miscellaneous
40	2-Hydroxythiophenol (Thiocatechol)	216 7 <sup>751</sup> , 88 90*	5-6		1 2373°									O-Me eth, b p 218-9, Di-Me eth, b p 237
41	Bis(2-mercaptoethyl) ether	217	- 80	1 5339	1 164825									4-Nitro- benzoyl, 106 5
42	1,5-Pentanedithiol	217 3, 110 <sup>16</sup>	-72 5											Dibenzoyl,
43	1-Nonanethiol (n- Nonyl mercaptan)	220 2	-20 I	1 45197	0 83714	86, 84 5	92			117 5		105-6	bр 211-26	
44	2-Isopropyl-5-methyl- benzenethiol (Thiothymol)	230-1										78, al	,	i
45	5-Isopropyl-2-methyl- benzenethiol (Thiocarvacrol)	235-6			0 997517 °						109			S-Me eth, bp 244
46	, ,	237 1	-210	1 5077 ≥5	0 988625									Dibenzoyl,
47	1-Naphthalenethiol (α-Mercapto naphthalene)	1285, 114 810 \$		1 6802	1 1607									Benzyl eth, 78-80, 4-Nitro- benzoyl, 121-30, Acetyl, b p, 200-325

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)
b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point °C	2,4-Di nitro phenyl thio- ether	2,4 Di- nitro- phenyl sulfone	Acetate	Benzoate	S-Alkyl mer capto- succinic acid	Disulfide	Methyl thio- ether	Miscellaneous
1	3-Hydroxythiophenol (Thio- resorcinol)	17	16835				dı 78		95	15 b p 224 sl d	Di-Me eth , b p 224-5
2	Hexadecanethiol (Cetyl mercaptan)	19	123-80 5	91,96	105			105	55 5	51 0	
3	1,10-Decanedithiol	20 17 8	297 1	}			di 57				D <sub>4</sub> 5 0 9432 n <sub>6</sub> 5 1 4940
4	Benzoylmethanethiol (2-Mercapto- acetophenone)	23 4	116 224						81		D <sub>4</sub> <sup>0</sup> 1 1753, Oxime, 70, Phenylhydrazone, 90 1
5	2-Aminothiophenol	26	234, 125-7 <sup>6</sup>	152		di 135			93	b p 234 sl d	injurazone, so t
6	3-Phenylenedithiol (Dithio- resorcinol)	27 1	245 1231				! !				Trinitrobenzene
7 8	4-Dimethylaminothiophenol 2-Phenylenedithiol (Dithiocatechol)	28 5 29	259 60 238 9	176		dı 885	di 74 5		118	; 	·
9	4-Hydroxybenzenethiol (Thio-hydroquinone)	30	144 620			S- 85 6, bz-lgr, di 66	75, <i>di</i> 161			84 5	S-Et eth , 39-41
10	threo-Dithiothreitol (threo-2,3- Dihydroxy-1,4 dithiobutane)	42 3	123-52			tetra 73, me al					Oxid → trans-4,5- dihydroxy-o-di- thiane, 132, Di- isopropylidene deriv 78, me al
	4-Thiocresol (4-Toluenethiol)	43-4	195	102 5 4	189 5	dı 66	dı 161				S-4-Tolyl deriv, 57 S-4-Nitrobenzoyl 114 5 S-Chloro- acetyl, 40
13	4-Chloro-1-naphthalenethiol 4-Aminothiophenol	43 4, al 46	140 516	i		N-mono 154 163, yel			122 82	bр 272 3	
	1,4-(Dimethylthio)-benzene (p- Xylylene dimercaptan)	46-7	15612				di 135		i		
15	5-Amino-2-methylthiophenol	47, bz - pet eth				di 125, yel, bz - pet eth				l47 lgr	Tri-Me eth, bp
	4-Chlorothiophenol 2-Hydroxy-1-naphthalenethiol	54 55, pet	123			O- 120,		163 4	73		
.,	2-11ydi Oxy-1-naphthatenethioi	eth				CCI <sub>4</sub> ,					
18	1,3,5-Benzenetrithiol	57 60		:		tri 73-4,				<i>tri</i> 66 8, al	
19 20	2-Nitrothiophenol 1-Amino-2-propanethiol	58 61 63 5		131 3					199 Dihydro- chloride,	64 5	Hydrochloride, 87- 8, al Picrate,
21	4-Bromothiophenol	75	231	142	190	51 2, me			94 5	38, al	143-4 d Benzenesulfonate, 75
	3-Nitrothiophenol 4-Nitrothiophenol	77 77		160	ļ	ai	123 7,		84 184	72	, , ,
ر ب	· , · · · · · · · · · · · · · · · · · ·	,				<u>.</u>	50°, ac a			-	
24 25	4-Nitro-1-naphthalenethiol 2-Naphthalenethiol (2-Mercapto- naphthalene)	77 9 81	286	193 145	228	53 5			189 139		4-Nitrobenzoył, 183-4, 2-Tolyl eth , b p 229 5''

<sup>\*</sup> Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS) b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	2,4-Di nitro phenyl thio- ether	2,4-D1- nitro- phenyl sulfone	Acetate	Benzoate	S-Alkyl mer- capto succinic acid	Disulfide	Methyl thio- ether	Miscellaneous
26	DL-ery thro-Dithiothreitol (erythro- 2,3-Dihydroxy-1,4-dithiobutane)	82 3, It pet eth				tetra 126, bz					Oxid cis-4,5-di- hydroxy-o-di- thiane, 132 Di-iso- propylidene deriv, 145, pet eth
27	4-lodothiophenol	85 6, al		140 5					124	45 38	CrO <sub>3</sub> /AcOH → sulfone, 83
28	4-Amino-1-naphthalenethiol	91 3		}		N-mono 173			168		
29	2-(3-Aminopropionamido)ethane- thiol (Aletherne)	93 6, subl 140 <sup>10</sup>				di 139 40, et ac					Hydrochloride, 214 7,95% al., Oxalate, 121 2, al
30 31	Bis (4-mercaptophenyl) ether 4-Phenylenedithiol (1,4-Dimer- captobenzene)	98 98, aq al				di 68 di 126, pet eth				di 85, me al	Di-Et eth ,815,al
32	2-Aminoethanethiol	98 100	130	94 5		di 30	1		Dihydro- chlo- ride, 216		Hydrochloride, 70 2, al , Picrate, 126 S-Acetyl hy- drochloride, 137
33	Triphenylmethanethiol	107		190		139-41	185	) .	ca 155	}	,
34	4-Bromo-2-nitrothiophenol	110		142							
35	4-Biphenylthiol	111 2, al		146	170				150	107 8,	
36	3-Amino-1-propanethiol	112 3							Dihydro- chlo- ride, 219	al	Hydrochloride, 69, dil al
37	1,8-Naphthalenedithiol	113 4, al								dı 84	
38	4-Hvdroxy-1-naphthalenethiol	114			1	di 77		1			1
39	Bis(4-thiophenyl)sulfide	114				di 65		]	190		
40	2,4,6-Trinitrothiophenol	114		217	1	ì	ĺ	1		•	İ
41	1,5-Naphthalenedithiol	118 21, yel				dı 187-9	dı 232			dı 250	
42	4-Chloro-2-nitrothiophenol	120 2		141							
43	2,4-Dinitrothiophenol	131 2		193 7	240 1	107	113	<b>!</b>	280		İ
44	6-Hvdroxy-2-naphthalenethiol	137, al				di 110, 107, al			221		
45	2-Benzothiazolthiol	177 9, aq me al			<u>.</u>	-				52, aq al	Et eth, 26 al
46	2,7-Naphthalenedithiol	181, 174,				di 110	dı 152-3				
<b>4</b> 7	1-Anthraquinonethiol	187, yel, ac a				:			>350.	218, yel, al	Et eth, 183, yel, al, Benzyleth, 241, yel, ac a
48	2-Anthraquinonethiol	206, yel , ac a							257	162, yel, ac a	Et eth, 138, yel, al, Benzyleth, 138, yel, al
49	2-Benzimidazolthiol	298, 296 7, dil al				:					Benzyleth, 186 7, 1-N-Me eth, 190-2

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLE XXVI

Sulfone \*

$$RSR' \xrightarrow{[O]} RSO_2R'$$

From the thioether in glacial acetic acid with dilute aqueous potassium permanganate

For directions and examples see Cheronis, p 641, Linstead, p 87, G W Fenton and C K Ingold, J Chem Soc., 2338 (1929), H Rheinboldt and E Giesbrecht, J Amer Chem Soc., 68, 973 (1946)

From the thioether with aqueous hydrogen peroxide in acetone or in acetic acid

See O Hinsberg, J prakt Chem, 90, 350 (1914), H Rheinboldt and E Giesbrecht, J Amer Chem Soc, 68, 973 (1946), C G Overberger, S P Lighthelm and E A Swire, J Amer Chem Soc, 72, 2856 (1950)

From the thioether with hydrogen peroxide and ammonium molybdate in aqueous perchloric acid See Cheronis, p 641

From the thioether with potassium bichromate and sulfuric acid in water

See G Raiziss, L W Clemence, M Severac and J C Moetsch, J Amer Chem Soc., 61, 2763 (1939)

From the thioether with chromic anhydride in glacial acetic acid

See C G Overberger, S P Lightelm and E A Swire, J Amer Chem Soc, 72, 2856 (1950)

For extensive lists of references for the oxidation of thioethers to the corresponding sulfones see A Schoberl and A Wagner in Methoden der Organischen Chemie (Houben-Weyl), Vol 9, (Ed E Miller), Georg Thieme Verlag, Stuttgart, 1955, pp 227-231, E E Reid, Organic Chemistry of Bivalent Sulfur, Vol 2, Chemical Publishing Co, New York, 1960, pp 64-65

Sulfoxide

From the thioether with hydrogen peroxide in acetic acid, in acetone or in alcohol-acetic acid mixture For directions and examples see O Hinsberg, Chem Ber, 43, 289 (1910), R L Shriner, H C Struck and W V Jorson, J Amer Chem Soc, 52, 2060 (1930), P Karrer, N J Antia and R Schwyzer, Helv chim Acta, 34, 1392 (1951)

From the thioether with perphthalic acid in ether

See H Bohme, Chem Ber, 70, 378 (1937)

From the thioether with chromic anhydride in aqueous acetic acid

See R Knoll, J prakt Chem, 113, 40 (1926)

For additional references for the oxidation of thioethers to the corresponding sulfoxides see A Schoberl and A Wagner in Modern Methoden der Organischen Chemie (Houben-Weyl), Georg Thieme Verlag, Stuttgart, 1955, pp 211-215

Mercuric halide addition compound

From the thioether with mercuric chloride, bromide or iodide in ethanol, acetone or aqueous solution For directions and examples see W F Faragher, J C Morrell and S Comay, J Amer Chem Soc, 51, 2774 (1929), E E Reid, Organic Chemistry of Bivalent Sulfur, Vol 2, Chemical Publishing Co, New York, 1960.

Mercuric halide or mercuric acetate derivative

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

#### **EXPLANATIONS AND REFERENCES TO TABLE XXVI (Continued)**

These derivatives are for substituted thiophenes only.

From the substituted thiophene with the mercuric salt (with or without sodium acetate) in ethanol or in acetic acid.

For directions and examples see: H. D. Hartough, Thiophene and its Derivatives, (The Chemistry of Heterocyclic Compounds, Vol. 3), Interscience, London, 1952, pp. 444-453.

For various additional compounds of thioethers with metal salts see: E. E. Reid, Organic Chemistry of Bivalent Sulfur, Vol. 2, Chemical Publishing Co., New York, 1960, pp. 52-60.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

<sup>\*</sup>Derivatives recommended for first trial.

### TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, *C	n <sub>D</sub> 20	D <sub>20</sub>	Sulfone	Sulfoxide	Disulfide	Miscellaneous
i	<b>Dimethyl sulfide</b> (Methyl sulfide)	37 3	-98 27	1 4356	0 845821	109 b p 238	18 45 bp 189	109 7	Tri-HgCl, add comp, 158 150 1, rapid htng Hgl, add comp, 75, SnBr, add comp, 85-7, PtCl, add comp 159 PtBr, add comp 159 PdCl, add comp, 130 PdBr, add comp, 125 AgNO, add comp, 126 126
2	Ethyl methyl sulfide	66 9	-1048	1 4353	0 8483	36, eth		130	HgCl <sub>2</sub> add comp , 128 Hgl <sub>2</sub> add comp 59 PdCl <sub>2</sub> add comp 67
		67 3		1 4845	0 9026	ļ		Į	į
	Divinyl sulfide (Vanyl sulfide)	84			0 9174		]	j	İ
5		91 3	-102 05	1 4712 1 44233	0 8767	73 4 bp 248	4 6, 15 bp 88 915	152 6 154	Disulfoxide 123 411 Mono-HgCl, add comp, 90 Di-HgCl, add comp, 119 5 Hgl, add comp 110 AgNO, add comp, 122 SnCl, add comp, 102 SnBr, add comp 84, PtCl, add comp, 106 PtBr, add comp, 118 Ptl, add comp 136, PdCl, add comp, 83 PdBr, add comp, 100
7	Ethyl vinyl sulfide	92	l	1 4756	0 8756	[	ł	[	ļ
3	Isopropyl methyl sulfide	93 5, 85	-101 48	ı	0 8291		l	ĺ	
	Methyl n-propyl sulfide	95 5	-112 98	f	0 8438	ì	1	1	Ì
10	tert-Butyl methyl sulfide	99 107 1	}	1 4402 1 4967	0 8257	}			į
	Chloromethyl methyl sulfide Ethyl isopropyl sulfide	107 1	-122 19	l .	0 8246	}	}	1	
The state of the s	Isobutyl methyl sulfide	112 5	1 - 122 19	1 4433	0 8335		ļ	İ	[
	Methyl 2-methylallyl sulfide	1130 2	ĺ	1 4712	0 0000	[	Į	ĺ	ĺ
15	Allyl ethyl sulfide	115 6	i		0 8676		]	ĺ	
16	Ethyl n-propyl sulfide	118 5, 110 2	-117 04	1 4461	0 84448	25, b p 142 <sup>23</sup>		173 7	
17	<b>Di-isopropyl sulfide</b> (Isopropyl sulfide)	120 7	- 78 08	1 4381	0 8135	36	68 5	176	PtCl <sub>2</sub> add comp, 163 PtBr <sub>2</sub> add comp, 174, PtI <sub>2</sub> add comp, 176, PtI <sub>4</sub> add comp, 139
18	n-Butyl methyl sulfide	122 5		1 4477	0 8427	}	1	}	HgCl <sub>2</sub> add comp , 116 5
19	Chloromethyl ethyl sulfide	128				33		bр 78 80¹⁵	
20	Isopropyl propyl sulfide	132		1 4440	0 8269	l	]	]	ļ
	sec-Butyl ethyl sulfide	133 6	]	1 4477	0 8353	}	]	Ì	
	Ethyl isobutyl sulfide	134 2	0.3	1 4452	0 8306				HgCl <sub>2</sub> add comp , 108
23	Diallyl sulfide (Allyl sulfide)	139 <sup>758</sup> , 35 <sup>5-7</sup>	[-83 	1 487727	0 8876527	bp 1093	bр 107- 9 <sup>7</sup> *	bр 78 80 <sup>16</sup>	
	Methyl 2-methylbutyl sulfide	139-40	1		0 841019	]	}	}	
- 1	2-Chloroethyl methyl sulfide Di-n-prapyl sulfide (n-Propyl sulfide)	140, 4420 141 2	-1019	1 4908 1 4481	1 1155 0 8358	30	14 5 5 0, bp 82 <sup>15</sup>	194	Mono-HgCl, add comp , 88 9 Di- HgCl, add comp 122 127 5 Chloroamine-T → sulfilimide,
27	n-Butyl ethyl sulfide	144 2	_95 13	1 4491	0 8376	50	]	193	110 15
1	Methyl pentyl sulfide (Amyl methyl sulfide)	144 5-5 5	- /3 [3]	1 448	0 843			173	HgCl <sub>2</sub> add comp, 127
29	Di-tert-butyl sulfide (tert-	150		1 4505				201, b p	
30	Butyl sulfide)  Diacetyl sulfide (Thioacetic anhydride)	155 8d , 63 <sup>20</sup>		1 481021	1 124			8821	Reduction → acetaldehyde, b p 20 2, 2,4-dinitrophenylhydrazone, 168
31	Dichloromethyl sulfide (Chloromethyl sulfide)	156 5	-54, -37	1 5313	1 4065	70 5-2 0			100
32	2-Chloroethyl ethyl sulfide	157, 63-5 <sup>47</sup>	- 51	1 06644	1 4878				

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

# TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n 20 D	D <sup>20</sup>	Sulfone	Sulfoxide	Disulfide	Miscellaneous
33	2-Aminoisopropyl methyl sulfide	158				bp 140⁴			1
34	Ethyl 3-methylbutyl sulfide	160	i	1 4495	0 8349	13 5	ļ	]	HgCl₂ add comp, 87
35	4-Chlorophenyl methyl sulfide	170		1 602325	1 122425	57 8	1	ì	
36	3-Aminopropyl methyl sulfide	170				44, b p 165 8 <sup>6</sup>	197		Hydrochloride, 136, Picrate, 127, Oxalate, 207d
37	<b>Di-isobutyl sulfide</b> (Isobutyl sulfide)	172 3		1 4463	0 8262	17, b p 265	68 5	215	Mono-HgCl <sub>2</sub> add comp, 116, Di- HgCl <sub>2</sub> add comp, 131, PtCl <sub>2</sub> add comp, (1) 83 (11) 139, PtBr <sub>2</sub> add comp, 143 4 Ptl <sub>2</sub> add comp, 187 PtCl <sub>3</sub> add comp, 162, AuCl <sub>3</sub> add comp, 87 PdCl <sub>2</sub> add comp, 95, PdBr <sub>2</sub> add comp, 140, PdI <sub>2</sub> add comp, 145
	<b>Di-2-methylallyl sulfide</b> (2- Methylallyl sulfide)	173							
39	sulfide	177 2753		1 5395	1 5258				- -
	Dicrotyl sulfide (Crotyl sulfide)	186 5, 88 9 <sup>20</sup>		1 49525	0 90320				
41	Di-n-butyl sulfide (n-Butyl sulfide)	188 0 182, 109 15 <sup>15</sup>	- 79 7	1 45405	0 8386	44, reso- hdifies at 32 5	33	231	DI-HgCl <sub>2</sub> add comp 113 110 5 PtBr <sub>2</sub> add comp 65 Ptl <sub>2</sub> add comp 67 PdCl <sub>2</sub> add comp , 32 Pd(NO <sub>3</sub> ) <sub>2</sub> add comp , 166, AgNO <sub>3</sub> add comp 98
42	4-Aminobutyl methyl sulfide	188 90				42 b p 165³			Hydrochloride, 153 4, acet Picrate, 116 8
43	Di-dichloromethyl sulfide (Di- chloromethyl sulfide)	189 62 410		1 5464	1 6273				
44	Methyl phenyl sulfide	194-6 78-9 <sup>13</sup>		1 5870	1 053325	88, w			
45	2-Chloroethyl chloromethyl sulfide	194 5 7710		1 5311	1 338				
	Benzyl methyl sulfide	195 8		1 555025	ļ	127, w			
47	Ethyl phenyl sulfide	205, 200-2		1 570115	1 02415	42, b p 16012			PdCl <sub>2</sub> add comp , 140
48	Isopropyl phenyl sulfide	208		1 5468	0 9855		ļ	ļ	PdCl₂add comp,162
49	Methyl 4-tolyl sulfide	211 2, 104-5 <sup>20</sup>		1 5753716	1 030216	89, bz - pet eth	50-4		
50	Di-(3-methylbutyl)sulfide (Isoamyl sulfide)	215 3		1 4471	0 8285	31, b p 295		250	PdCl <sub>2</sub> add comp, 95 PdBr <sub>2</sub> add comp, 133 PdI <sub>2</sub> add comp, 143, SnCl <sub>4</sub> add comp, 64, SnBr <sub>4</sub> add comp, 45 6
51	Allyl phenyl sulfide	215-8, 104-6 <sup>25</sup>		1 5760	1 0275				
52	Di-2-chloroethyl sulfide (2- Chloroethyl sulfide, Mustard gas, Yperite)	217	14 4	1 53125	1 2741	56, b p 183 <sup>20</sup>	109-11	;	
53	Phenyl propyl sulfide	219~20		1 5571	0 9995	44	İ		PdCl <sub>2</sub> add comp, 91
54	Ethyl 4-tolyl sulfide	220 1		1 5568	1 001617 5	55 6	1	}	i
55	Benzyl ethyl sulfide	222 3, 98-9 <sup>13</sup>				84		İ	Mono-HgCl <sub>2</sub> add comp , 84, D <sub>1</sub> - HgCl <sub>2</sub> add comp , 142
1	3-Methylbutyl phenyl sulfide	240-2		1 5380	0 9681	36			PdCl <sub>2</sub> add comp, 97
57	2-Chioroethyl phenyl sulfide	245, 121 15		1 5838	1 1799	45			
ı	2-Chloroethyl 4-tolyl sulfide	255-7, 150-2 <sup>20</sup>				78			
59	2-Hydroxyethyl 4-tolyl sulfide	282-3, 119 20 <sup>1</sup>				55			
60	<b>Di-(3-tolyf)sulfide</b> ( <i>m</i> -Tolyl sulfide)	290, 17412				94	bр 215 <sup>15</sup>	bр 150 d	

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

## TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point *C	Melting point *C	u 50	D²⁰	Sulfone	Sulfoxide	Disulfide	Miscellaneous
61	Diphenyl sulfide (Phenyl sulfide)	296, 157- 8 <sup>16 5</sup>	-21 5	1 6312	1 1160	128-9, bp 379	70 5	61	Disulfone of the disulfide, 193-4
62	Di-n-heptyl sulfide (n-Heptyl sulfide)	298				80			
63	4-Chlorophenyl phenyl sulfide	305-15d , 167-8 <sup>10</sup>				34, 90			
64	Phenyl 3-tolyl sulfide	309 5, 164 5 <sup>11</sup>	-65		1 093716				
65	Phenyl 2-tolyl sulfide	309 9 300 5, 160 5 <sup>11</sup>			1 101215	81, al			
66	Phenyl 4-tolyl sulfide	311 5, 167 5 <sup>11</sup>	15 7		1 0900 <sup>15</sup> ?	127-8 al			

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) a) Liquids 2) Cyclic (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n 20	Dặ⁰	Sulfone	HgCl <sub>2</sub> addition compound	Miscellaneous
1	Ethylene sulfide (Thurane Thiacyclopropane)	55-6		1 4914	1 0046			Polymerizes rapidly
	2-Methylethylene sulfide (2-Methylthurane) Thiophene	76 84 12	- 38 30	1 47319	0 946 <sup>18</sup> 1 0644			2-HgCl deriv, 182-3; 2-HgBr deriv, 169-70, 2-HgI deriv, 116-7
4	2,2-Dimethylethylene sulfide (2,2-Dimethyl-thurane)	87,84 6		1 4641				2-11g1 doily , 110-7
5	Trimethylene sulfide (Thietane Thiacyclo- butane)	95	-73 25	1 50623	1 0200	76, w	93 5 d	Methiodide, 98 5-9 0
6 7	2-Ethylethylene sulfide (2-Ethylthurane) 2-Methyltrimethylene sulfide (2-Methyl- thietane)	104 106		1 47519	0 930 <sup>18</sup> 0 9571	bp 251 5- 35		
8	2-Methylthiophene	1124		1 52042	1 02183			5-HgCl deriv , 204, 5-HgBr deriv , 179-80, 5-HgI deriv , 111-2
9	2,4-Dimethyltrimethylene sulfide (2,4-Di- methylthietane)	113 4		1 45021×	0 871018	b p 255 0 5 5		
10	3-Methylthiophene	115 4		1 52042	1 02183			2-HgCl deriv, 128-9, 2,5- Di-HgOOCCH <sub>3</sub> deriv, >240d
11	2,2-Dimethyltrimethylenesulfide (2,2-Di- methylthietane)	120		1 4739¹*		55	118	
12	Tetramethylene sulfide (Thiolane Thiophane Thiophane)	121 2, 120 2 5	-96 17	1 5047	0 99869	28 36	128	Sulfoxide, 105-712
13	2-Methyltetramethylene sulfide (2-Methyl- thiolane)	132 5750	- 100 71	1 4922	0 9555	bр 279- 80 <sup>75н</sup>	di 162	
14	2-Ethylthiophene	132 5-4 0		1 5127	0 99024			5-HgCl deriv , 147-8, 5-Hg deriv , 96-7
15	3-Ethylthiophene	135 6		1 5146	0 9980			2-HgCl deriv, 67-8, 2,5-Di HgCl deriv, 295-7d
16	2,5-Dimethylthiophene	135 5 6 0	- 62 57	1 5126	0 98587			3-HgCl deriv, 156-7, 3-Hg deriv, 175
17	2,4-Dimethylthiophene	137 8, 140		1 5130	0 9956			5-HgCl deriv, 138-9, 5-Hg deriv, 137-9
18	3-Methyltetramethylene sulfide (3-Methyl- thiolane)	138 2	-81 10	1 4924	0 9634	1,05	83	
19	2,3-Dimethylthiophene	140 2-1 2	-49 l to -48 9	1 5188	1 0021			5-HgCl deriv, 218 5-9 5, 5-Hgl deriv, 184 0-4 5, 4,5-Di-HgOOCCH,, 237-40
20	trans-2,5-Dimethyltetramethylene sulfide (trans-2,5-Dimethylthiolane)	142	- 76 35	1 4766	0 9188	3, b p 278	111	237-40
21	,	142 3		1 4799	0 9222	4, b p 278	di 180	
22	3,4-Dimethylthiophene	144 6		1 5212	1 00821			2-HgCl deriv , 139-40 5, 2-HgBr deriv , 152, 2-HgI deriv , 142
	1,4-Thioxane 2-Methylpentamethylene sulfide (2-Methyl- thiane)	148 9 151	17 58 14	1 5070 1 4905	1 1177 0 9428	130, 105 5 68 5	171 102	Sulfoxide, 25, 45
	2-Isopropylthiophene	152		1 5037	0 9673	ļ		6 11 61 1 127
	3-Isopropylthiophene 3-Methylpentamethylene sulfide (3-Methyl-	155 7, 157 157-8	-60 17	1 5052 1 4922	0 9733 0 9473	83	136	5-HgCl deriv , 137
28	thiane) <b>2-Ethyltetramethylene sulfide</b> (2-Ethylthiolane)	157 8		1 4896	0 9451		mono 100, di 146~8	
29	2-Propylthiophene	157 5 9 5		1 5048	0 9683		ui 140~8	5-HgCl deriv , 155, 5- HgSCN deriv , 169 0-9 5
30	4-Methylpentamethylene sulfide (4-Methyl- thiane)	158 6	-28 11	1 5049	0 9687	121 5	136	11g3CN ucity , 107 0~9 3
31	tniane) <b>2-Ethyl-5-methylthiophene</b>	159 8 60 4	-686	1 5073	0 9663			

<sup>\*</sup>Derivative data given in order  $\ m\ p$  , crystal color, solvent from which crystallized

## TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) a) Liquids 2) Cyclic (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D²⁰	Sulfone	HgCl <sub>2</sub> addition compound	Miscellaneous
32	2-Ethyl-3-methylthiophene	160 0 1 5		1 509222 >	0 979222 5			5 HgCl deriv , 172-3, 5-Hgl deriv , 156-7
33	2,6-Dimethyl-1,4-thioxane	160 1	Ì	1 4733		105 5		,
34	3-Propylthiophene	160 2	ł	1 5057	0 9716			
35	2-Allylthiophene	161, 158 5 9 0		1 528120 >	1 017520 7			
36	3,5-Dimethyl-1,4-thioxane	162	1			102		
37	3-Ethyl-5-methylthiophene	162 4	~ 60 to - 59	1 5098	0 9742			
38	2,3,5-Trimethylthiophene	163 5, 164 5 46		1 5131	0 9753			x-HgCl deriv, 160-1
39	2-tert-Butylthiophene	163 9	-59 2	1 49788	0 9514		ļ	ļ
40	3-tert-Butylthiophene	168 9	- 54 8	1 50149	0 9574	Į		
41	Hexamethylene sulfide (Thiepane Thiacyclo heptane)	170 173 4		1 5125	0 9883	71	149	Methiodide, 141 5-2 0
42	2,3,4-Trimethylthiophene	172 7 160 3		1 5208	0 995		:	
43	1,3-Dithiolane(1,3-Dithiacyclopentane)	175		1 597515	1 2591	di 205	117, 126	Methiodide, 96, Disulf- oxide, 134
44	2-Methyl-5-propylthiophene	179 5 80 5	1	1 5026				, -
45	Cyclohexene sulfide (7-Thiabicycloheptane)	180 71 5- 3 5 <sup>21</sup>		1 5309	0 9274			
46	2-n-Butylthiophene	181-2740	}	1 50896	0 9537			
47	2,5-Diethylthiophene	181-2, 63- 6 <sup>14</sup>		1 5036	0 96214			
48	3-n-Butylthiophene	181 3		1 51005	0 9570	!	l	Į
49	2,3,4,5-Tetramethylthiophene	182 4 187 9		1 5196	0 944221			
50	3,4-Diethylthiophene	185-7	1	1 515717	<b>\</b>	}		2-HgCl deriv, 118
	2-Ethyl-1,3-dithiolane	191 2	[	1		124		= '
52	2,4-Dimethyltetramethylene sulfide (2,4-Dimethylthiolane)	197 8-42		1 4818	0 9265	bp 123 35	89	
53	3-Ethyl-2,4,5-trimethylthiophene	204 6748	ì	1 5132	0 9609	}		
54	2-n-Octylthiophene	257 9, 106 8 <sup>1</sup>		1 4824	0 920			

<sup>\*</sup>Derivative data given in order m p, crystal color, solvent from which crystallized

### TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	Ethyl 2-naphthyl sulfide	16	170 515	43 5			
3		19 19 07, 13	142	88 98 5 9 0			D <sub>4</sub> <sup>o</sup> 0 9849, n <sub>D</sub> <sup>o</sup> 1 5067, HgCl <sub>2</sub> add comp, 137 5, al, Meth rodide, 192 subl
4		20	1	di 304			louide, 172 subi
5	Didecyl sulfide (Decyl sulfide)	27	217 8*	206 7	l		[
6 7	3-Tolyl 4-tolyl sulfide Diundecyl sulfide (Undecyl sulfide n-Hendecyl sulfide)	27 8 al 34 8	17911	116 ac a	72		
8 9		35 35		111 2			
10	sulfide)  2-Aminophenyl phenyl sulfide (2-Amino- diphenyl sulfide)	35 6, al	21225	122, dil al			N-Benzenesulfonyl, 225 6
11	4-Bromophenyl methyl sulfide	37 5	ļ	56 7	ļ	ļ	
12	[- , , ,	40 5		1		34 5	
13	Benzyl phenyl sulfide	41 44 5,	1972	146 6 5	123		1
14	Di-(4-chlorobenzyl)sulfide (4-Chlorobenzyl sulfide)	41		148, al		59	
15	1-Naphthyl phenyl sulfide	41 8, aq al	220 511	99 5 100 5 al			
	3-Nitrophenyl phenyl sulfide (3-Nitrodiphenyl sulfide)	42 5		80 5 81			
17		44	Į	138 5	l		
18 19		44 5 46		115 3	96	45	Disulfone, 221, r h 210 2, s h
20	'	48, al				133, 128	
21	-	50, chl		151 7, al bz	134 8	73	D <sub>30</sub> 1 0712 HgCl <sub>2</sub> add comp, 131, Hgl <sub>2</sub> add comp, 37 8, FeCl <sub>3</sub> add comp, 94 PtCl <sub>2</sub> add comp 159 PtCl <sub>4</sub> add comp 172d, PtBr <sub>2</sub> add comp 139 Ptl <sub>2</sub> add comp 129
	2,5-Dichlorophenvl methyl sulfide Methyl 2-naphthyl sulfide	51 51 8 64	22611	88	47.5		D 16 166
,	Bis(phenylthio)methane	52	220.	115 6, al di 120-1	67 5		Disulfone, 166
	Ditetradecyl sulfide (n-Tetradecyl sulfide)	53 8		21 120-1		46	
26	Di-(2-diphenoxyethyl)sulfide	54 al		108, pink, al		97	
	1,3-Dithiane	54		di 330 308			
- 1		55 55, yel lgr	24025	di 216 142, aq al			
30	Di-n-octyl sulfide(n-Octyl sulfide)	57		76		bр 178- 83 <sup>5</sup>	
- 1	Di-(4-tolyl)sulfide (4-Tolyl sulfide)	57 3	17911	158, bz	95, pet eth	48, al	
	2-Aminophenyl 4-aminophenyl sulfide (2,4'- Diaminodiphenyl sulfide)	61, 62 5, aq al		124-6		-	Diacetyl, 208
	Dihexadecyl sulfide (n-Hexadecyl sulfide)	61 3		103 4	99 8		
	2-Chloroethyl 4-nitrophenyl sulfide Dı-(2-tolyl)sulfide (2-Tolyl sulfide)	62 64, al	285, 17415	128 134 5, al	121, pet eth	38-9, al	
36	Methyl 2-nitrophenyl sulfide	64 5, yel , al		106			D <sub>4</sub> <sup>8</sup> <sup>2</sup> 1 2626, n <sub>D</sub> <sup>8</sup> <sup>2</sup> 1 62458, AgNO <sub>3</sub> add comp, 122, yel, al
37	Benzyl 4-bromophenyl sulfide	65		159			,

<sup>\*</sup>Derivative data given in order mp, crystal color, solvent from which crystallized

### TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
38	1,2-Bis(phenylthio)ethane	69 70		di 180			
39	Dioctadecyl sulfide (Octadecyl sulfide)	71,645		l .		62 5	
40	2-Phenyl-1,3-dithiane	71-2	Į.	dı 265			
41	Methyl 4-nitrophenyl sulfide	72		141			D <sub>4</sub> <sup>80 1</sup> 1 2391, n <sub>D</sub> <sup>80 1</sup> 1 64008
42	Di-(3-phenylpropyl)sulfide (3-Phenylpropyl sulfide)	73		117		bр 165- 6 <sup>0 өз</sup>	
43	Di-(2-methoxyphenyl)sulfide (2-Anisyl sulfide)	73, al	252-310	157-8, bz		120	
	Di-(4-methylbenzyl)sulfide (4-Methylbenzyl sulfide)	76		197			
45	Cinnamyl phenyl sulfide	78		111 2	90 1		
	4-(Methylthio)benzaldehyde	78, yel , lgr	273, 15317				Phenylhydrazone, 138, Thiosemi- carbazone, 177-9, yel
47	4-Nitrobenzyl phenyl sulfide	79	ſ	209 5			
	1,2-Bis(tolylthio)ethane	80 1		di 200 1		İ	
	2-Nitrophenyl phenyl sulfide (2-Nitrodiphenyl sulfide)	80 2, 77, yel	21015	147 5, al			
50	Di-(2-aminobenzyl) sulfide	81	į			90 l lgr et ac	N,N'-Diformyl, 163 N,N'- Diacetyl, 209 Picrate, 203 4d
51	4-Nitrophenyl 4-tolyl sulfide	81 5, yel	ļ	170 1, yel			
52	Di-(2-aminophenyl) sulfide	87		146 7		93, al	N,N'-Diacetyl, 164 5 N,N'- Dibenzoyl, 162 3
53	Di-(2-phenylethyl) sulfide (2-Phenylethyl sulfide)	92 5 90		100 6	69	bp 172 50 ×	
54	4-Aminophenyl phenyl sulfide (4 Amino- diphenyl sulfide)	96, lgr	24329	176, al	152, w		Hydrochloride, 197 8d N-4- Toluenesulfonyl, 73
55	Di-(4-amino-3-methylphenyl) sulfide	96 25°, al					Dihydrochloride, 248-9 dil HCl N,N'-Diacetyl, 22, al, N,N'- Dibenzoyl, 233, me al, Dipicrate, 186, w
56	Di-(4-chlorophenyl) sulfide (4-Chlorophenyl sulfide)	98 88 90	2121#	148 9, subl	143	73	•
57	3-Aminophenyl 4-nitrophenyl sulfide (3-Amino-4'-nitrodiphenyl sulfide)	99 100					N-Acetyl, 115-6, N N-Dimethyl, 83 4
58	Di-(2-amino-5-methylphenyl) sulfide	103 4, al				98	Dihydrochloride, 100d, al, N,N' Diacetyl, 165, al, N,N'-Di- benzoyl, 185, 6, al, Diurethane, 113, bz, -pet, eth, Dipicrate, 179, bz
59	Di-(4-aminobenzyl) sulfide	104 5				96 8, al	N,N'-Diacetyl, 188, N,N'- Dibenzoyl, 224
60	Di-(4-aminophenyl) sulfide	108 9, w		178, me al	175d, al	85 106, al	N,N'-Diacetyl, 220 1 N,N' Dibenzoyl, 234
61	Di-(1-naphthyl) sulfide	110, al	29015	187, al	166, al	91	
62	1,4-Dithiane	111 2	199-200	mono 200, di >330			Methiodide, 73 4, Sulfoxide- sulfone, 279
63	Di-(4-bromophenyl) sulfide (4-Bromophenyl sulfide)	112, al	24320	172	153, al	94 5	
64	2,4-Dinitrophenyl phenyl sulfide (2,4-Dinitrodiphenyl sulfide)	121, 117, bz		161			
65	Di-(2-nitrophenyl)sulfide (2-Nitrophenyl sulfide)	122 3, yel, al-ac a		164		198-9, ac a or bz	
66	Benzyl 4-nitrophenyl sulfide	123	1	172			1
	Di-(3-hydroxyphenyl) sulfide (3-Hydroxyphenyl			190 1, 186-7	94 5, pet eth	95	Acetyl, 87
	sulfide)	140	1	di 156-7	****	i	
68	1,3-Bis (2-nitrophenylthio) propane D1-(2-hydroxyphenyl) sulfide (2-Hydroxyphenyl			179, 164-5,		b p >200d	Diacetyl, 95-6, al Di-Me eth, 73
70	- · · · · · · · · · · · · · · · · · · ·	151	291 215	bz 123			
71	sulfide) Di-(2-naphthyl)sulfide (2-Naphthyl sulfide)	151	29615	177, al	137 5 8 5	139	

<sup>\*</sup>Derivative data given in order m p., crystal color, solvent from which crystallized

# TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES) b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Nаme	Melting point °C	Boiling point, *C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
72	Di-(4-hydroxyphenyl) sulfide (4-Hydroxyphenyl sulfide)	151, al		240 l, w	195, acet	150 1	Diacetyl, 94 55, Di-Me eth , 46, Di-Et eth 55
73	<b>Di-(4-nitrobenzyl) sulfide (</b> 4-Nitrobenzyl sulfide)	158-9		260 5	212	126 5	
74	Di-(4-nitrophenyl) sulfide (4-Nitrophenyl sulfide)	174-5, 156 7, or,orpa yel		282, 245 225		182, ac a	
75	<b>Di-(3-nitrophenyl) sulfide</b> (3-Nitrophenyl sulfide)	193		201		84, al	
76	Di-(2,4-dinitrophenyl) sulfide (2,4-Dinitro phenyl sulfide)	193 7 193 4, yel, ac a		240 1		280	
77	Di-(2,4,6-trinitrophenyl) sulfide (Dipicryl sulfide)	230 1 226, yel		307			

<sup>\*</sup>Derivative data given in order im p , crystal color, solvent from which crystallized

#### EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation

$$HA_{aq}^{\pm n} + H_2O \implies A_{aq}^{\pm n-1} + H_3O_{aq}^{+}$$

and the corresponding equilibrium constant  $K_{\rho}$  is given by

$$K_e = \frac{(a_{\text{A}} \frac{\pm n-1}{\text{aq}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{H}_4} \frac{\pm n}{\text{aq}})(a_{\text{H}_2\text{O}})}$$

where the a's are the activities of the species At low electrolyte concentrations  $a_{H,O}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}}^{\pm n-1})(a_{\text{H}_3\text{O}^+})}{(a_{\text{H}_4}^{\pm n})} = \frac{(c_{\text{A}_{\text{aq}}}^{\pm n-1})(c_{\text{H}_2\text{O}^+})}{(c_{\text{H}_4}^{\pm n})} \cdot \frac{f_{\pm}^2}{f_{\text{H}_4}^{\pm n}}$$

where the c's are the concentrations and the f's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pKa = -\log K_a$$

For Table XXVII,  $HA^{\pm n} = RCOOH$ , and  $A^{\pm n-1} = RCOO^-$ For Table XXVIII,  $HA^{\pm n} = ArOH$ , and  $A^{\pm n-1} = ArO^-$ For Table XXIX,  $HA^{\pm n} = RR'R''NH^+$  and  $A^{\pm n-1} = RR'R''N(R, R')$  and R'' may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids  $pK_a = pK_1$ 

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $A^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for pK determinations, see G Kortum, W Vogel and K Andrussow, in Pure and Applied Chemistry, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, Dissociation Constants of Organic Bases in Aqueous Solution, Butterworths, London, 1965

For general references including methods of determination of pK, and data for both acids and bases see J F King, in Elucidation of Structures by Physical and Chemical Methods, Vol 1 (Ed K W Bently) (Technique of Organic Chemistry, Vol 9), Interscience, New York, 1963, Chapter 6, pp. 318-401, H. C. Brown, D. H McDaniel and O Hafliger in Determination of Organic Structures by Physical Methods, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

### TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION (Listed in order of increasing pKa)

No	Name	T,°C	pΚι	pK <sub>2</sub>	No	Name	T °C	pK,	pK <sub>2</sub>
1	Heptafluoro-n-butyric acid	25	0 17		51	1,3,5-Benzenetricarboxylic acid	25	2 12	3 89
2	Trifluoroacetic acid	25	0 23				1		$pK_3 = 4.70$
3	Trichloroacetic acid	25	0 63	1	52	D,L-3,5-Di-iodotyrosine	25	2 12	6 48
4	2,4,6-Trinitrobenzoic acid	25	0 65		53	3-(2-Fluorophenyl)alanine	24	2 12	9 01
5	Tribromoacetic acid	25	0 66		54	3-(4-Fluorophenyl)alanine	24	2 13	9 05
6	3-Chlorophenylglycine	25	1 05	3 93	55	D,L-β-Phenylalanine	25	2 16	9 15
7	2,6-Dinitrobenzoic acid	25	1 14		56	/-Lysine	25	2 16	9 18
8	Trichloroacrylic acid	25	1 15	ļ	!!		1	1	$pK_3 = 10.7$
9	Difluoroacetic acid	25	1 24	ļ	57	d-Lysine	25	2 16	9 16
10	Oxalic acid	25	1 27	4 28	ll	•	İ	ł	$pK_3 = 10.8$
11	Dichloroacetic acid	25	1 29	1	58	Glutamic acid	20	2 16	4 324
12	2-Chloro-6-nitrobenzoic acid	25	1 34				1		$pK_3 = 996$
13	2-Bromo-6-nitrobenzoic acid	25	1 37		59	6,6,6-Trifluoronorleucine	25	2 164	9 463
14	Benzenehexacarboxylic acid	25	1 40	2 19	60	3-(3-Chlorophenyl)alanine	25	2 17	8 91
			ı	$pK_3 = 3.31$	61	2-Chloro-5-nitrobenzoic acid	25	2 17	Į.
				$pK_4 = 4.78$	62	D,L-Serine	25	2 21	4 15
				$pK_5 = 5.89$	63	Diethylmalonic acid	25	2 21	7 29
				$pK_6 = 6.96$	64	N-Propylalanine	25	2 21	10 19
	d,l-2,3-Dibromosuccinic acid	20	1 42	3 24	65	N-Ethylalanine	25	2 22	10 22
16	2,4-Dinitrobenzoic acid	25	1 42		66	D,L-N-Methylalanine	25	2 22	10 19
17	erythro-2-Bromo-3-chlorosuccinic acid	19	1 43	2 60	67	2-Nitrobenzoic acid	25	2 22	
18	d,l-2,3-Dichlorosuccinic acid	20	1 46	2 86	68	3-(2-Chlorophenyl)alanine	25	2 23	8 94
19	threo-2-Bromo-3-chlorosuccinic acid	20	1 46	2 77	69	6-Bromo-2-methylolbenzoic acid	20	2 25	
20	meso-2,3-Dibromosuccinic acid	20	1 51	2 71	70	6-Chloro-2-methylolbenzoic acid	20	2 26	]
21	meso-2,3-Dichlorosuccinic acid	20	1 52	2 94	71	d,l-Valine	25	2 286	9 744
22	4,4,4-Trifluorovaline	25	1 537	8 098	72	d,l-2-Aminobutyric acid	25	2 29	9 83
23	4,4,4-Trifluorothreonine	25	1 554	7 822	73	2-Benzyl-2-cyanopropionic acid	25	2 29	}
24	2-Amino-4,4,4-trifluoro-n-butyric acid	25	1 600	8 169	74	2-Amino-n-pentanoic acid	25	2 318	9 808
25	2,5-Dinitrobenzoic acid	25	1 62		75	(3,4-Dihydroxyphenyl)alanine	25	2 32	8 68
26	Nitroacetic acid	25	1 68			·	l	1	$pK_3 = 988$
27	Triffuoroacrylic acid	25	1 79		76	2-Chloro-3-hydroxysuccinic acid	25	2 32	
28	Benzenepentacarboxylic acid	25	1 80	2 73	77	3-Hydroxyglutaric acid	25	2 32	4 24
				$pK_3 = 3.97$	il .		1		$pK_3 = 9.56$
				$pK_4 = 5.25$	78	d,l-Leucine	25	2 32	9 74
				$pK_5 = 646$	79	d,l-Norleucine	25	2 335	9 83
29	Cyclopropane-1,1-dicarboxylic acid	25	1 82	5 43	80	d,l-Alanine	25	2 34	9 87
30	Hydroxyproline	25	1 82	9 66	81	cis-Caronic acid (cis-1,1-Dimethyl-2,3-	25	2 34	8 31
31	DL-Histidine	25	1 82	6 04	11	cyclopropanedicarboxylic acid)	ł	1	
				$pK_3 = 9.12$	82	N-Ethylglycine	25	2 34	10 23
32	2,3-Dinitrobenzoic acid	25	1 85		83	Glycine	25	2 35	9 78
33	2-Methyl-4-nitrobenzoic acid	25	1 86		84	N-Methylglycine	25	2 35	10 18
34	1,2,4,5-Benzenetetracarboxylic acid	25	1 92	2 87	85	N-Propylglycine	25	2 35	10 19
ļ				$pK_3 = 449$	86	N-n-Butylglycine	25	2 35	10 25
				$pK_4 = 563$	87	N-Isobutylglycine	25	2 35	10 12
35	trans-Ethylene oxide-1,2-dicarboxylic acid	19	1 93	3 25	88	2-Aminoisobutyric acid	25	2 36	10 25
36	cis-Ethylene oxide-1,2-dicarboxylic acid	18	1 94	3 92	89	(Methylsulfonyl)acetic acid	25	2 36	Ì
37	Maleic acid	25	1 94	6 23	90	2-Cyano-2-cyclohexylacetic acid	25	2 37	1
38	Ornithine	25	1 94	8 65	91	2-Cyanopropionic acid	25	2 37	[
39	2-Chloro-4-nitrobenzoic acid	25	1 96		16	D,L-Tryptophane	25	2 38	9 39
40	4-Aminosalicylic acid (4-Amino-2-	25	1 99	3 92		1,2,3,5-Benzenetetracarboxylic acid	25	2 38	3 51
	hydroxybenzoic acid)						ļ	l	$pK_2 = 444$
41	2-Chloro-3-nitrobenzoic acid	25	2 02						$pK_3 = 5.81$
42	Asparagine	25	2 05	3 87	94	4-Aminobenzoic acid	25	2 38	\
	Anthranilic acid	25	2 05	4 95	95	2-Cyanoisobutyric acid	25	2 42	İ
	5,5,5-Trifluoroleucine	25	2 05	8 92	16	Cyanoacetic acid	25	2 46	
- 1	S-Ethylcysteine	25	2 05	8 60	H	Pyruvic acid	25	2 49	
	1,2,3,4-Benzenetetracarboxylic acid	25	2 06	3 25	98	O-Acetylcitric acid	25	2 49	[.
		[	-	$pK_3 = 4.73$	n '	3-Pentenoic acid	25	2 51	1
Į		1		$pK_1 = 621$	11	1,2,4-Benzenetricarboxylic acid	25	2 52	3 84
<b>4</b> 7	Di-n-propylmalonic acid	25	2 07	7 51		• • • • • • • • • • • • • • • • • • • •	1		$pK_3 = 520$
	3-(4-Chlorophenyl)alanine	25	2 08	8 96	101	(2-Chlorovinyl)acetic acid	25	2 54	1
	3-(3-Fluorophenyl)alanine	24	2 10	8 98	II I	Oxaloacetic acid	25	2 55	4 37
	Arginine	25	2 10	9 07	11	Fluoroacetic acid	25	2 58	
					11	· · · · · · · · · · · · · · · · · · ·	1		1

(Listed in order of increasing pKa) (Continued)

No	Name	T,°C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T,°C	pK <sub>1</sub>	pK <sub>2</sub>
104	Phenylmalonic acid	25	2 58	5 03	162	(2,4-Dichloro-6-methylphenoxy)acetic	20	3 13	
105	2-Chloro-3-hydroxybutyric acid	25	2 58			acid			
106	2-Fluoroacrylic acid	25	2 58		163	2-Cyanobenzoic acid	25	3 14	
107	2,4-Dioxo-n-pentanoic acid	25	2 58		164	1,	25	3 14	
108	2-Chloro-3-hydroxy-3-phenyl	25	2 61		11	Ethyl-n-propylmalonic acid	25	3 15	7 43
	propionic acid				1	4,4,4-Trifluorocrotonic acid	25	3 15	
109	2-Chloro-6-hydroxybenzoic acid	25	2 63		II.	(4-Iodophenoxy)acetic acid	25	3 16	
	2-Butynoic acid (Tetrolic acid)	25	2 65		13	(2-Iodophenoxy)acetic acid	25	3 17	
111	1-Aminocyclohexanecarboxylic acid	25	2 66	4.00	II .	3,3-Difluoroacrylic acid	25	3 17	. 00
112	Bromosuccinic acid	50	2 69	4 69	1	Dimethylmalonic acid	25	3 17	6 06
113	3-Hydroxy-2-naphthoic acid	25	2 71	5 84	171	1	25 25	3 17	
114	5-Aminosalicylic acid (5-Amino-2- hydroxybenzoic acid	23	2 74	204	1	lodoacetic acid	20	3 18	
115	Triethylsuccinic acid	25	2 74	į	,	3-lodo-2-methylolbenzoic acid	25	3 20	
	Salicylic acid (2-Hydroxybenzoic acid)	30	2 75.	12 38	1	2-Hydroxy-3-chloroisobutyric acid (4-Methoxyphenoxy)acetic acid	25	3 21	
110	Sancyne acid (2-riyuroxyochizoic acid)	30	(3 00)	12 30		(4-Methylphenoxy)acetic acid	25	3 22	
117	2,4-Dichlorobenzoic acid	25	2 76		1	meso-Tartaric acid	25	3 22	4 82
117 118	1,2,3-Benzenetricarboxylic acid	25	2 80	4 20	ı	2-Chlorocrotonic acid	25	3 22	7 02
110	1,2,5-Denzenen icarboxyne aciu	1	2 30	$pK_3 = 5.87$	1	2,4-Dihydroxybenzoic acid	30	3 22	
119	3.4-Dinitrobenzoic acid	25	2 82	P163 = 301		(2-Methoxyphenoxy)acetic acid	25	3 23	
120	3,5-Dinitrobenzoic acid	25	2 82		2	(2-Methylphenoxy)acetic acid	25	3 23	
121	Guanidinoacetic acid	25	2 82	}	182	1	25	3 23	4 08
122	2-Bromobenzoic acid	25	2 85		183	1 * *	25	3 23	
123	Malonic acid	25	2 86	5 65	184	3-Chloromandelic acid	25	3 24	1
124	Chloroacetic acid	25	2 86		1	2,6-Dimethylbenzoic acid	25	3 25	
125	Ethylmethylmalonic acid	25	2 86	6 43	186	3-lodomandelic acid	25	3 26	
126	2-lodobenzoic acid	25	2 86		187	2-Fluorobenzoic acid	25	3 27	
127	2-Chloropropionic acıd	18	2 88		188	3-Chloro-2-methylbenzoic acid	25	3 27	
128	(4-Nitrophenoxy)acetic acid	25	2 89		189	(4-Chloro-2-methylphenoxy)acetic acid	25	3 28	
129	Bromoacetic acid	25	2 90		190	3-Bromo-2-methylbenzoic acid	20	3 28	
130	2-Chlorobenzoic acid	25	2 92		191	cis-3-Chloroacrylic acid	18	3 32	
131	(4-Cyanophenoxy)acetic acid	25	2 93		192	cis-Cyclopropane-1,2-dicarboxylic acid	24	3 33	6 47
132	Isopropylmalonic acid	25	2 94	5 38	193	(2,6-Dimethylphenoxy)acetic acid	25	3 36	
133	(3-Nitrophenoxy)acetic acid	25	2 95			Anthraquinone-1-carboxylic acid	20	3 37	
134	Phthalic acid	25	2 95	5 41	195	3-Hydroxy-3-phenylpropionic acid	18	3 40	
135	2-Chloroisobutyric acid	18	2 97		196	d,l-Mandelic acid	25	3 41	
136	3,5-Dinitro-4-methylbenzoic acid	25	2 97		1	Anthraquinone-2-carboxylic acid	20	3 42	
137	(2-Cyanophenoxy)acetic acid	25	2 97		1 1	N-Formylglycine	19	3 43	
138	2-Bromopropionic acid	18	2 97		1 1	2,4,6-Trimethylbenzoic acid	25	3 44	
139	Ethylmalonic acid	25	2 99	5 83		3-Nitrobenzoic acid	25	3 44	
140	n-Propylmalonic acid	25	2 996	5 84	201	Cyclohexane-1,1-diacetic acid	25	3 45	7 08
141	d-Tartaric acid	25	3 00	4 34	202	2-Phenylbenzoic acid (Biphenyl-2-	25	3 46	
142	Fumaric acid	25	3 02	4 38	ا ا	carboxylic acid)			
143	(3-Cyanophenoxy)acetic acid	25	3 03			meso-2,3-Diphenylsuccinic acid	25	3 48	
144	Benzilic acid	18	3 05	[		(2,4-Dinitrophenyl)acetic acid	25	3 50	7.30
144	Methylmalonic acid	125	2 05	570		Tetramethylsuccinic acid	25	3 50	7 28
146	•	25 25	3 05	5 76		d,l-2,3-Diethylsuccinic acid	25	3 51	6 60
	(2-Chlorophenoxy)acetic acid 3,3,3-Trifluoropropionic acid	25	3 05 3 06			2-Phenoxybenzoic acid	20	3 53	
149	3-Aminobenzoic acid	25	3 06	4 73	208	2-Hydroxy-2-phenylpropionic acid	18	3 53	
150	(3-Chlorophenoxy)acetic acid	25	3 07	7'3	210	Terephthalic acid	25	3 54	4 46
151	2-Hydroxy-3-chlorobutyric acid	25	3 08	ļ	210	2-tert-Butylbenzoic acid	25	3 54	4 40
152	(3-Fluorophenoxy)acetic acid	25	3 09	1		3-Aminopropionic acid	25	3 55	
153	(2-Fluorophenoxy)acetic acid	25	3 09	!	213	4-Cyanobenzoic acid	25	3 55	
154	(4-Chlorophenoxy) acetic acid	25	3 10			3-(Methylamino)benzoic acid	25	3 55	
155	(3-Bromophenoxy) acetic acid	25	3 10	]	215	3-Methoxy-2-methylolbenzoic acid	20	3 58	
156	$\alpha$ -lodopropionic acid	18	3 11		1	d,l-2,3-Diphenylsuccinic acid	25	3 58	
157	(2-Bromophenoxy)acetic acid	25	3 12		217	2-Aminocyclohexanecarboxylic acid	25	3 59	10 21
158	3-Chlorolactic acid	25	3 12		218	3-Cyanobenzoic acid	25	3 60	
159	(4-Bromophenoxy)acetic acid	25	3 13		219	3-Ethoxy-2-methylolbenzoic acid	20	3 62	
160	(3-Iodophenoxy)acetic acid	25	3 13		220	Isophthalic acid	25	3 62	4 60
	(4-Fluorophenoxy)acetic acid	25	3 13		221	3-Ethyl-3-methylglutaric acid	25	3 62	6 70
101	(4-Fidorophenoxy)acetic acid	23	3 13		221	3-Euryi-3-metnyigiutaric acid	25	3 02	6 /0

#### TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION (Listed in order of increasing pKa) (Continued)

No	Name	T °C	pK,	pK <sub>2</sub>	No	Name	T °C	pK,	pK <sub>2</sub>
	3,3-Diethylglutaric acid	25	3 62	7 12	279	cis-Tetrahydronaphthalene-2,3-	20	3 98	6 47
,	meso-2,3-Diethylsuccinic acid	25	3 63	6 46	<b>'</b>	dicarboxylic acid	}	}	<b>\</b>
	(2,4-Dichlorophenoxy) acetic acid	20	3 64		280	4-Chlorobenzoic acid	25	3 98	1
225	Malonamic acid (Malonic acid mono-	25	3 64	İ	281	2,5-Dimethylbenzoic acid	25	3 98	1
	amide)	ĺ			282	3-Bromopropionic acid	18	3 99	İ
226	2-Isopropylbenzoic acid	25	3 64		283	2-Hydroxy-2-methylbutyric acid	18	3 99	
227	Decahydronaphthyloxyacetic acid	25	3 64		284	3-Cyanopropionic acid	25	3 99	
228	2-Cyclohexyloxypropionic acid	25	3 64	Į	285	3-Chloropropionic acid	25	3 996	l
229	trans-3-Chloroacrylic acid	18	3 65		286	trans-Tetrahydronaphthalene-2,3-	20	4 00	5 70
230	9-Anthracenecarboxylic acid	20	3 65		ll .	dicarboxylic acid	1		
231	Ethoxyacetic acıd	18	3 65		287	(2-Nitrophenyl)acetic acid	25	4 004	Ì
232	trans-Cyclopropane-1,2-dicarboxylic	24	3 65	5 13	288	3-Ammopentanoic acid	25	4 02	10 40
}	acid	1	1		289	4-Aminobutyric acid	25	4 03	1
233	N-Acetylglycine	25	3 67	1	290	cts-Cyclobutane-1,3-dicarboxylic acid	25	4 03	5 31
	1-Anthracenecarboxylic acid	20	3 68	<u> </u>	291	2-Hydroxyisobutyric acid	18	4 04	}
	2-Benzyl-2-phenylsuccinic acid	20	3 69	6 49	292	(2-Iodophenyl)acetic acid	25	4 04	ĺ
- 1	3,3-Di-n-propylglutaric acid	25	3 69	7 31	293	trans-4-Nitrocinnamic acid	25	4 05	
	Cyclopentyloxyacetic acid	25	3 70	1	294	(2-Bromophenyl)acetic acid	25	4 05	
	3,3-Dimethylglutaric acid	25	3 70	6 29	295	(2-Chlorophenyl)acetic acid	25	4 07	
	cis-3-Aminocyclohexanecarboxylic acid	15	3 70	1	296	2-Methoxybenzoic acid	20	4 08	
- 1	d,l-N-Acetylalanine	25	3 72		290	3-Methoxybenzoic acid	25	4 09	1
- 1	· ·	25	3 72	1	II .	•	1		l
	N-Propionylglycine 2,3-Dimethylbenzoic acid	25	3 74	1	298 299	3-Iodopropionic acid	18	4 09	5 46
- 1	Formic acid	25	3 74	}	II	cis-Cyclohexane-1,3-dicarboxylic acid	16	1	3 46
		25	3 75		300	Ethylsuccinic acid	25	4 00	0.61
244	Phthalamic acid (Phthalic acid mono-	23	3 /3	}	301	Iminodipropionic acid	30	4 11	961
	amide)	۱			302	Benzylsuccinic acid	20	4 11	5 65
1	Glutaconic acid	25	3 77	5 08	303	trans-3-Nitrocinnamic acid	25	4 12	ļ
	meso-2,3-Dimethylsuccinic acid	25	3 77	5 94	304	4-Fluorobenzoic acid	25	4 14	
1	2-Ethylbenzoic acid	25	3 79		305	(3-Chlorophenyl)acetic acid	25	4 14	
	3-Methylcyclopentyl-1,1-diacetic acid	25	3 79	6 74	306	4,4,4-Trifluorobutyric acid	25	4 15	
249	trans-Cyclobutane-1,2-dicarboxylic acid	20	3 79	5 61	307	trans-2-Nitrocinnamic acid	25	4 15	
250	Cyclohexyloxyacetic acid	25	3 80		308	3-Isopropoxybenzoic acid	20	4 15	
251	2-Hydroxybutyric acid	18	3 80		309	2-Naphthoic acid	25	4 16	
252	Cyclopentyl-1,1-diacetic acid	25	3 80	6 77	310	Succinic acid	25	4 16	5 61
253	3-Bromobenzoic acid	25	3 81	ĺ	311	(3-Iodophenyl)acetic acid	25	4 16	
254	3-Chlorobenzoic acid	25	3 82	1	312	3-Ethoxybenzoic acid	20	4 17	
255	trans-Caronic acid (trans-1,1 Dimethyl-	25	3 82	5 32	313	2,2-Diphenyladipic acid	20	4 17	5 80
1	2,3-cyclopropanedicarboxylic acid)			1	314	(4-Iodophenyl)acetic acid	25	4 18	
256	2,2-Diethylsuccinic acid	25	3 84		315	2-Anthracenecarboxylic acid	20	4 18	
257	trans-3-Aminocyclohexanecarboxylic acid	15	3 85		316	trans-Cyclohexane-1,4-dicarboxylic acid	16	4 18	
258	3-Iodobenzoic acid	25	3 85		317	4,4,5,5,6,6,6-Heptafluorohexanoic acid	25	4 18	
- 1	(4-Nitrophenyl)acetic acid	25	3 85	]	318	2,4-Dimethylbenzoic acid	25	4 18	
	cis-3-Methylcyclohexyloxyacetic acid	25	3 85	[	319	trans-Cyclohexane-1,2-dicarboxylic acid	19	4 18	5 93
- 1	Lactic acid	25	3 86		320	(4-Bromophenyl)acetic acid	25	4 19	- /5
- 1	cis-Cinnamic acid	25	3 88		321	(4-Chlorophenyl)acetic acid	25	4 19	
	Hydroxyacetic acid	25	3 89			Mesaconic acid	18	4 20	
. 1	1,2,3-Cyclohexanetricarboxylic acid	23	3 89	4 85	323	Benzoic acid	25	4 20	
			5 37	$pK_3 = 883$	324	3-Propoxybenzoic acid	20	4 20	
265	cis-Cyclobutane-1,2-dicarboxylic acid	19	3 90	5 89	324	• •	1 1		
	2-Methylcyclohexyloxyacetic acid	25	3 90	""	1 1	2-Ethoxybenzoic acid	20	4 21	5 10
- 1	• • •	25		}	326	3,4-Diphenyladipic acid	25	4 22	5 19
	3-Fluorobenzoic acid	30	3 90	0.70	327	trans-2-Chlorocinnamic acid	25	4 23	
	3-Hydroxybenzoic acid		3 90	9 78	328	3-Fluoromandelic acid	25	4 24	
	2-Methylbenzoic acid	25	3 91		329	(1-Naphthyl)acetic acid	25	4 24	
- 1	2,2-Diphenylglutaric acid	20	3 91	5 38	330	(2-Isopropoxy)benzoic acid	20	4 24	
- 1	3-Phenoxybenzoic acid	20	3 91		331	2-Propoxybenzoic acid	20	4 24	
- 1	2-(Bromomethyl)butyric acid	18	3 92	ĺ	332	3-Butoxybenzoic acid	20	4 25	
	Diphenylacetic acid	25	3 94		333	(4-Fluorophenyl)acetic acid	25	4 25	
- 1	2,2-Dibenzylsuccinic acid	20	3 96	6 66	334	Acrylic acid	25	4 25	
- 1	Triphenylacetic acid	25	3 96	) 1	335	3-Methylglutaric acid	25	4 25	5 41
	trans-Cyclopentane-1,2-dicarboxylic acid	25	3 96	5 85	336	(2-Naphthyl)acetic acid	25	4 26	
222	4-Bromobenzoic acid	25	3 97		337	cis-Cyclopentane-1,3-dicarboxylic acid	25	4 26	5 51
	(3-Nitrophenyl)acetic acid	25							

(Listed in order of increasing pKa) (Continued)

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	т °С	pK <sub>1</sub>	pK <sub>2</sub>
	3-Methylbenzoic acid	25	4 27		401	3-(2-Chlorophenyl)propionic acid	25	4 58	
- 1	2,2-Diphenylpimelic acid	25	4 28	5 39	402	3-(3-Chlorophenyl)propionic acid	25	4 58	
l l	3-Ethylglutaric acid	25	4 29	5 33	403	4-Methyl-3-pentenoic acid	25	4 60	
	Angelic acid	18	4 29		404	cis-3-Hydroxycyclohexanecarboxylic acid	25	4 60	
	trans-3-Chlorocinnamic acid	25	4 29		405	2-Hydroxycinnamic acid	25	4 61	0.31
	3,5-Dimethylbenzoic acid	25	4 30		406	4-Hydroxybenzoic acid	27 8	4 61	9 31
	3-Isopropylglutaric acid	25 25	4 30	5 51	407	Levulinic acid	18	4 64	
	3-n-Propylglutaric acid Phenylacetic acid	25	4 31	5 31	408		18 25	4 65 4 65	
	trans-Cyclohexane-1,3-dicarboxylic acid	19	4 31	5 73	410	3-(3-Methoxyphenyl)propionic acid 4-Acetylbutyric acid	18	4 66	
	2,2-Diphenylsuberic acid	20	4 31	5 39	I i	2-Methylacrylic acid	18	4 66	
1	trans-Cyclopentane-1,3-dicarboxylic acid	25	4 32	5 42	1	3-Phenylpropionic acid	25	4 66	
	2,2-Diphenylazelaic acid	20	4 33	5 38	413	3-(2-Methylphenyl)propionic acid	25	4 66	
1	(3,4-Dimethoxyphenyl)acetic acid	25	4 33		414	4-Pentenoic acid	25	4 67	i
- 1	3,4,5-Trihydroxybenzoic acid	30	4 33			4-Ureidobutyric acid	25	4 68	
	cis-Cyclohexane-1,2-dicarboxylic acid	20	4 34	6 77	416	3-(3-Methylphenyl)propionic acid	25	4 68	
	4-Isopropylbenzoic acid	25	4 35		417	3-(4-Methylphenyl)propionic acid	25	4 68	
356	Vinylacetic acid	25	4 35		418	(4-Isopropoxy)benzoic acid	20	4 68	
357	Glutaric acid	25	4 35	5 42	419	trans-2-Hydroxycyclohexanecarboxylic	25	4 68	
358	4-Ethylbenzoic acid	25	4 35			acid			
	(4-Methoxyphenyl)acetic acid	25	4 36	ł	420	trans-4-Hydroxycyclohexenecarboxylic	25	4 68	
	4-Methylbenzoic acid	25	4 37	]	]	acid			
	(4-Methylphenyl)acetic acid	25	4 37	ľ	421	3-(4-Methoxyphenyl)propionic acid	25	4 69	
	(4-Ethylphenyl)acetic acid	25	4 37			2-Pentenoic acid	25	4 69	2)
-	4-Methoxycinnamic acid	25	4 38	5.40	423	trans-Crotonic acid	25	4 69	
- 1	trans-Cyclohexane-1,2-diacetic acid	20	4 38	5 42	424	4-Hydroxypentanoic acid	18	4 69	
	(4-Isopropylphenyl)acetic acid	25	4 39	10.55	425	2-Hexenoic acid	25	4 70	
- 1	trans-4-Aminocyclohexanecarboxylic acid	25	4 39	10 55	426	4-Hexenoic acid 5-Hexenoic acid	25	4 72	
	3-Hydroxycinnamic acid	25 25	4 40		427		25 18	4 72 4 72	
	4-tert-Butylbenzoic acid cis-Crotonic acid	18	4 40		428 429	2-Ethylpentanoic acid 2-Ethylbutyric acid	25	4 75	
	3,4-Di nethylbenzoic acid	25	441		430	4-Phenylbutyric acid	25	476	
- 1	trans-2-Bromocinnamic acid	25	4 41		431	Acetic acid	25	4 76	
•	cis-Cyclohexane-1,2-diacetic acid	20	4 42	5 45	432	Isovaleric acid	25	4 78	
	cis-Cyclopentane-1,2-diacetic acid	20	4 42	5 42	433	4-Propoxybenzoic acid	20	4 78	
ì	(4-tert-Butylphenyl)acetic acid	25	4 42			4,4-Dimethylpentanoic acid	18	4 79	
	trans-Cyclopentane-1,2-diacetic acid	20	4 43	5 43	435	Cyclobutanecarboxylic acid	25	4 79	
	trans-4-Chlorocinnamic acid	25	4 43		436	d,l-2-Methylpentanoic acid	18	4 79	
377	Adipic acid	25	4 43	5 42	437	5-Methyl-4-hexenoic acid	25	4 80	
378	4-Cyanobutyric acid	25	4 44		438	4-Methyl-2-pentenoic acid	25	4 80	
379	trans-Cinnamic acid	25	4 44		439	3-(2-Methoxyphenyl)propionic acid	25	4 80	
380	trans-3-Methylcinnamic acid	25	4 44		440	2-Methylbutyric acid	18	4 81	
	3-(Acetylamino)propionic acid	25	4 45		441	n-Butyțic acid (n-Butanoic acid)	25	4 82	
	2-Ureidoisobutyric acid	25	4 46		442	trans-3-Hydroxycyclohexanecarboxylic	25	4 82	
	4-Methoxybenzoic acid	25	4 47	! <b>!</b>	] .	acid	]		
	3-(4-Nitrophenyl)propionic acid	25	4 47		443		25	4 82	11 98
	Pimelic acid	25	4 48	5 42	444	Cyclopropanecarboxylic acid	25	4 83	10.72
	3-(1-Naphthoyl)propionic acid	20	4 48		445	cts-4-Aminocyclohexanecarboxylic acid	25	4 83	10 62
	3-Methylcyclohexyl-1,1-diacetic acid	25	4 49	6 08	446	d,l-3-Methylpentanoic acid	18	4 84	12.22
	4-Methylcyclohexyl-1,1-diacetic acid 5,5,5-Trifluoropentanoic acid	25	4 49	6 10	447	Isonicotinic acid	20 25	4 84	12 23
	3-Ureidopropionic acid	25 25	4 49 4 49	·	448 449	cis-4-Hydroxycyclohexanecarboxylic acid Isocaproic acid	18	4 84	
	3-(2-Nitrophenyl)propionic acid	25	4 50	, I	450	n-Pentanoic acid (n-Valeric acid)	25	4 84	•
	trans-2-Methylcinnamic acid	25	4 50	·	450	Isobutyric acid	25	4 86	
	2-Methoxycinnamic acid	25	4 50		452	Propionic acid (Propanoic acid)	25	4 87	
- 1	3-Hexenoic acid	25	4 52		453	4-Hydroxyisocaproic acid	18	4 87	,
	Suberic acid	25	4 52	5 40		n-Hexanoic acid (n-Caproic acid)	25	4 88	
	Azelaic acid	25	4 53	5 40		n-Heptanoic acid	25	4 89	
		-				n-Octanoic acid (n-Caprylic acid)	25	4 89	
398	Succinamic acid (Succinic acid mono-	25	4 54		457	Cyclohexylpropionic acid	25	4 91	
	amide)				458	d,l-2,3-Dimethylsuccinic acid	25	4 94	6 20
399	trans-4-Methylcinnamic acid	20	4 56	İ	459	n-Nonanoic acid (Pelargonic acid)	25	4 94	
	O-Acetylsalicylic acid (Aspirin)	17	4 57		460	Cyclohexylbutyric acid	25	4 95	

#### TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION (Listed in order of increasing pKa) (Continued)

No	Name	T °C	pΚι	pK <sub>2</sub>	No	Name	T °C	pK,	pK <sub>2</sub>
461	Tiglic acid	18	4 96		468	cis-3-Methyl-2-pentenoic acid	25	5 15	
462	3-(2-Naphthoyl)propionic acid	20	4 96		469	Itaconic acid	18	5 54	
463	Cyclopentanecarboxylic acid	25	4 99		470	Citraconic acid	18	6 17	
464	2,2-Dimethylbutyric acid	18	5 03		471	Ethylenediamine-N,N,N,N'-tetra-	25	6 27	10 95
465	Trimethylacetic acid	25	5 05		ll .	acetic acid		[	
466	3,3-Dimethylacrylic acid (3-Methyl-	25	5 12		472	Ethylenediamine-N,N -diacetic acid	30	6 42	9 46
	crotonic acid)				473	Ethylenediamine-N,N'-dipropionic acid	30	6 87	9 60
467	trans-3-Methyl-2-pentenoic acid	25	5 13				1		

#### EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation

$$HA_{aq}^{\pm n} + H_2O = A_{aq}^{\pm n-1} + H_3O_{aq}^{+}$$

and the corresponding equilibrium constant  $K_{\rho}$  is given by

$$K_e = \frac{(a_{\text{A}} \frac{\pm n-1}{\text{aq}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{H}_4} \frac{\pm n}{\text{aq}})(a_{\text{H}_2\text{O}})}$$

where the a's are the activities of the species At low electrolyte concentrations  $a_{H,O}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}}^{\pm n-1})(a_{\text{H}_3\text{O}^+})}{(a_{\text{H}_4}^{\pm n})} = \frac{(c_{\text{A}_{\text{aq}}}^{\pm n-1})(c_{\text{H}_2\text{O}^+})}{(c_{\text{H}_4}^{\pm n})} \cdot \frac{f_{\pm}^2}{f_{\text{H}_4}^{\pm n}}$$

where the c's are the concentrations and the f's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pKa = -\log K_a$$

For Table XXVII,  $HA^{\pm n} = RCOOH$ , and  $A^{\pm n-1} = RCOO^-$ For Table XXVIII,  $HA^{\pm n} = ArOH$ , and  $A^{\pm n-1} = ArO^-$ For Table XXIX,  $HA^{\pm n} = RR'R''NH^+$  and  $A^{\pm n-1} = RR'R''N(R, R')$  and R'' may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids  $pK_a = pK_1$ 

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $A^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for pK determinations, see G Kortum, W Vogel and K Andrussow, in Pure and Applied Chemistry, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, Dissociation Constants of Organic Bases in Aqueous Solution, Butterworths, London, 1965

For general references including methods of determination of pK, and data for both acids and bases see J F King, in Elucidation of Structures by Physical and Chemical Methods, Vol 1 (Ed K W Bently) (Technique of Organic Chemistry, Vol 9), Interscience, New York, 1963, Chapter 6, pp. 318-401, H. C. Brown, D. H McDaniel and O Hafliger in Determination of Organic Structures by Physical Methods, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

## TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS IN AQUEOUS SOLUTION

(Listed in order of increasing pKa)

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK,	pK <sub>2</sub>
1	Picric acid (2,4,6-Trinitrophenol)	25	0 29			2-Hydroxy-3-methoxybenzylamine	25	8 70	10 52
			(0.71)		1	3-Hydroxypyridine	20	8 72	
2	4-Hydroxypyrimidine	20	1 85	8 59		2-Fluorophenol	25	8 82	1
3	2-Hydroxypyrimidine	20	2 24	9 17	54	, , , , , , , , , , , , , , , , , , , ,	25	8 889	
4	4-Chloro-2,6-dinitrophenol	25	2 97 3 71			Hydroxy-4-methoxybenzaldehyde)	1	1	
5 6	2,6-Dinitrophenol	25	4 09	1	55	3-Hydroxy-2-methoxybenzylamine	25	8 89	10 52
7	2,4-Dinitrophenol 2,6-Dinitrohydroquinone	21	4 42	9 14	I		25	8 94	10 42
8	8-Hydroxyquinoline	20	5 017	9 813	57	3-Nitro-2,4,6-trimethylphenol	25	8 98	
9	2,5-Dinitrophenol	25	5 04	7 0.5	58 59	Sodium 4-hydroxybenzenesulfonate  Pyrogallol (1 2 3-Trihydroxybenzene)	25 25	901	11 64
10	3,4-Dinitrophenol	25	5 42		60	2-Methylhydroquinone (Toluhydroquinone)	25	9 05	11 62
11	8-Hydroxyquinaldine	25	5 55	10 31	61	3-Chlorophenol	25	9 08	11.02
12	4-Methyl-8-hydroxyquinoline	25	5 58	10 00		o carotopacao.	123	(9 02)	
13	3,4-Dimethyl-8-hydroxyquinoline	25	5 80	10 05	62	3-Bromophenol	25	911	1
14	5-Formyl-2-nitrophenol (3-Hydroxy-4-nitro-	25	6 00	İ	63	3-Iodophenol	25	9 17	
	benzaldehyde)		Ì	] }	64	3-Acetylphenol	25	9 19	1
15	5-Chloro-2-nitrophenol	25	6 05		65	4-lodophenol	25	9 20	
16	5-Carboethoxy-2-nitrophenol (Ethyl 3-	25	6 11	İ	66	Sodium 3-hydroxybenzenesulfonate	25	9 29	1
	hydroxy-4-nitrobenzoate)				67	1-Naphthol	20 5	9 30	]
17	5-Carbomethoxy-2-nitrophenol (Methyl 3-	25	6 15					(9 85)	
	hydroxy-4-nitrobenzoate)				68	3-(Methylsulfonyl)phenol	25	9 33	
18	2,4-Dimethyl-8-hydroxyquinoline	25	6 20	10 60	69	4-Bromophenol	25	9 34	
19	3-Nitrocatechol	25	6 68		70	3-Fluorophenol	25	9 36	
20	2-Nitro-5-phenylphenol (3-Hydroxy-4-	25	6 74					(9 28)	
	nitrobiphenyl)	۱ ۵۰	. 70	Ì	71	1,4-Naphthohydroquinone (1 4 Dihydroxy	26 5	9 37	10 93
21	2-Formylphenol (Salicylaldehyde)	25	6 79			naphthalene)			
22	5-Methoxy-2-nitrophenol	25 25	7 09 7 16		72	4-Chlorophenol	25	9 38	
23 24	4-Nitrophenol 2-Nitrophenol	25	7 21				1	(9 42)	1
25	2,6-Dimethyl-4-nitrophenol	25	7 22	ļ,	73	Sodium 4-hydroxybenzoate	20	9 39	
26	5-Methyl-2-nitrophenol	25	7 25	Ì	74	Resorcinol (1.3 Dihydroxybenzene)	30	9 44	11 32
27	2,6-Dichlorohydroquinone	25	7 30	9 99	75 76	Catechol (1 2-Dihydroxybenzene)	30	9 48	12 08
28	Vanillin (4-Formyl-2-methoxyphenol 4-	25	7 396	, , ,	77	4-Phenylphenol (4 Hydroxybiphenyl) 3-(Methylthio)phenol	22 5	9 53	
- 1	Hydroxy-3-methoxybenzaldehyde)				78	4-(Methylthio)phenol	25	9 53	[
29	2-Nitrohydroquinone	21	7 63	10 06	79	2,4,6-Trimethylolphenol	25	9 56	
30	4-Formylphenol (4-Hydroxybenzaldehyde)	25	7 66		80	2-Naphthol	19 5	9 57.	
31	4-(Methylsulfonyl)phenol	25	7 83					(9 93)	
33	o-Vanillin (2-Formyl-6-methoxyphenol,	25	7 91		81	3-Phenylphenol (3-Hydroxybiphenyl)	22 5	9 64	
	2-Hydroxy-3-methoxybenzaldehyde)				82	3-Methoxyphenol	25	9 65	Ī
34	4-Cyanophenol (4-Hydroxybenzonitrile)	25	7 95	. !!	83	2,6-Dimethylolphenol	25	9 66	
35	3-Formylphenol (3-Hydroxybenzaldehyde)	25	8 00		84	2-Aminophenol (2-Hydroxyaniline)	28	9 71	ŀ
36	4-Acetylphenol	25	8 05	J.	85	2,4-Dimethylolphenol	25	9 77	
37	3,5-Dimethyl-4-(methylsulfonyl)phenol	25	8 13	1	86	4-Methylolphenol	25	9 82	
38	4-Cyano-3,5-dimethylphenol (2,6-Dimethyl-4-	25	8 21	ļ,	87	3-Methylolphenol	25	9 83	<b>.</b>
	hydroxybenzonitrile)	ا ي	0.35		88	3-Aminophenol (3-Hydroxyanılıne)	21 5	9 87	9 92
39		25	8 25	ļļ	89	Sodium 4-hydroxybenzenephosphonate	25	9 90	
40	4-Cyano-2,6-dimethylphenol (3,5-Dimethyl-4-	25	8 27	li li		3-Ethylphenol 2,6-Dimethylol-4-methylphenol	28 25	9 90	
ابر	hydroxybenzonitrile)	20	8 37		91	2,6-Dimethylol-4-methylphenol 2-Methylolphenol	25	9 92	
41 42	• • • • • • • • • • • • • • • • • • • •	25	8 38	ll ll	93	4-Fluorophenol	25	9 92	
43	4-Carbobenzyloxyphenol (Benzyl 4-hydroxy-	25	8 41		94	Sodium 3-hydroxybenzoate	20	9 94	
73	benzoate)		· · ·		95	2-Methoxyphenol	25	9 98	
44	2-Bromophenol	25	8 42		96	Phenol	25	9 99,	
45	Phloroglucinol (1,3,5-Trihydroxybenzene)	25	8 45	8 88			1	(9 95)	
- 1	(-,u,u - · · · · · ) at a v ) a v · · · · · · · · · · · · · · · · · ·		(7 0)	- /	97	Eugenol (4-Allyl-2-methoxyphenol)	25	10 00	
46	2-lodophenol	25	8 46	II.	98	2-Phenylphenol (2-Hydroxybiphenyl)	22 5	10 01	
47	4-Carbobutoxyphenol (n-Butyl 4-hydroxy-	25	8 47		99	4-Ethylphenol	28	10 01	
	benzoate)				100	3-Methylphenol (m-Cresol)	25	10 09	
48	4-Carbomethoxyphenol (Methyl 4-hydroxy-	25	8 47	- 11	101	3-Ethyl-5-methylphenol	28	10 10	
l	benzoate)				102	3,5-Dimethylphenol	25	10 15	
49	2-Chlorophenol	25	8 48	11	103	4-Methyl-2-methylolphenol	25	10 15	
50	4-Carboethoxyphenol (Ethyl 4-hydroxy-	25	8 50	{{	104	4-Methoxyphenol	25	10 20	
	benzoate)		- 1	H	105	Sodium 3-hydroxybenzenephosphonate	25	10 2	

#### TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS IN AQUEOUS SOLUTION (Listed in order of increasing pKa)

No.	Name	T, °C	pK,	pK <sub>2</sub>	No	Name	T, °C	pK,	pK <sub>2</sub>
106	2-Ethylphenoi	28	10 2		115	2,6-Dimethylphenol	25	10 59	
107	2,5-Dimethylphenol	24	10 22		116	2,4,6-Trimethylphenol	25	10 88,	1
108	4-Methylphenol (p-Cresol)	25	10 26	<b>[</b>	<b>{</b> {		- 1	(10 99)	,
109	2-Methylphenol (o-Cresol)	25	10 28	l	117	Hydroquinone (1,4-Dihydroxybenzene)	25	10 85,	11 39
110	4-Indanol	25	10 32	1	íi I		- 1	(9 96)	i
111	3,4-Dimethylphenol	25	10 32	<b>1</b>	118	4-Hydroxypyridine	20	11 09	1
112	2,4,5-Trimethylphenol	25	10 45	ļ	119	Tetramethylhydroquinone (Durohydro-	25	11 51	ļ.
113	2,4-Dimethylphenol	25	10 45			quinone)	- 1	1	
114	2,3-Dimethylphenol	25	10 50	1	120	2-Hydroxypyridine	20	11 62	1

#### EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation

$$HA_{aq}^{\pm n} + H_2O \implies A_{aq}^{\pm n-1} + H_3O_{aq}^{+}$$

and the corresponding equilibrium constant  $K_{\rho}$  is given by

$$K_e = \frac{(a_{\text{A}} \frac{\pm n-1}{\text{aq}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{H}_4} \frac{\pm n}{\text{aq}})(a_{\text{H}_2\text{O}})}$$

where the a's are the activities of the species At low electrolyte concentrations  $a_{H,O}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}}^{\pm n-1})(a_{\text{H}_3\text{O}^+})}{(a_{\text{H}_4}^{\pm n})} = \frac{(c_{\text{A}_{\text{aq}}}^{\pm n-1})(c_{\text{H}_2\text{O}^+})}{(c_{\text{H}_4}^{\pm n})} \cdot \frac{f_{\pm}^2}{f_{\text{H}_4}^{\pm n}}$$

where the c's are the concentrations and the f's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pKa = -\log K_a$$

For Table XXVII,  $HA^{\pm n} = RCOOH$ , and  $A^{\pm n-1} = RCOO^-$ For Table XXVIII,  $HA^{\pm n} = ArOH$ , and  $A^{\pm n-1} = ArO^-$ For Table XXIX,  $HA^{\pm n} = RR'R''NH^+$  and  $A^{\pm n-1} = RR'R''N(R, R')$  and R'' may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids  $pK_a = pK_1$ 

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $A^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for pK determinations, see G Kortum, W Vogel and K Andrussow, in Pure and Applied Chemistry, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, Dissociation Constants of Organic Bases in Aqueous Solution, Butterworths, London, 1965

For general references including methods of determination of pK, and data for both acids and bases see J F King, in Elucidation of Structures by Physical and Chemical Methods, Vol 1 (Ed K W Bently) (Technique of Organic Chemistry, Vol 9), Interscience, New York, 1963, Chapter 6, pp. 318-401, H. C. Brown, D. H McDaniel and O Hafliger in Determination of Organic Structures by Physical Methods, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

<sup>\*</sup>Derivatives recommended for first trial

(Listed in order of increasing pKa)

No	Name	T °C	pK,	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
1	2,4,6-Trinitroaniline	25	-941		59	2-Amino-6-nitronaphthalene	25	2 62	····
2	2,4-Dinitroaniline	25	-4 53		60	N,N-Dimethyl-3-nitroaniline	25	2 63	
3	2,6-Dinitro-4-methylaniline	25	-3 96		61	2-Chloroaniline	25	2 65	
4	2,4-Dichloro-6-nitroaniline	25	-361		62	2-Amino-4-cyanonaphthalene	25	2 66	
5	2,6-Dichloro-4-nitroaniline	20	-2 55		63	1-Amino-3-bromonaphthalene	25	2 67	
6	N-Cyanodiethylamine	25	-20		64	3-Bromoquinoline	25	2 69	
7	1-Amino-2-nitronaphthalene	25	-1 74		65	1-Amino-3-chloronaphthalene	25	2 69	
8	4-Chloro-2-nitroaniline	25	-1 02		66	5-Nitroquinoline	20	2 69	
9	Dicyanomethyl ethyl amine	25	-06		67	6-Nitroquinoline	20	2 72	
10	2-Fluoropyridine	25	-0 44		68	1-Amino-5-nitronaphthalene	25	2 73	
11	Pyrrole	25	-0 27		69	2-Amino-8-nitronaphthalene	25	2 73 2 748	
	2-Nitroanilme	25	(-3 8) -0 26		70	3-Cyanoaniline	25 23	2 748	
12	Bis (cyanomethyl) amine	25	0 2			1-Amino-8-nitronaphthalene 1-Amino-3-iodonaphthalene	25	2 82	
14	2-Chloropyridine	25	0 49,		73	3-Bromopyridine	25	2 84	
177	2-Cinoropyriume	23	(0.72)		Į.	3-Chloropyridine	25	2 84	
15	1-Amino-4-nitronaphthalene	20	0 54		1	1-Amino-6-nitronaphthalene	25	2 89	
16	Ouinoxaline	20	0 56		76		25	2 96	
17	N,N-Dimethyl-4-nitroaniline	25	0 607		77	3-Cyano-N,N-dimethylaniline	25	2 969	•
18	Pyrazine	27	0 65	-5 78	78	3-Fluoropyridine	25	2 97	
19	Diphenylamine	25	0 79	- 10	79	2-Amino-5-nitronaphthalene	25	3 01	
20	3-Nitropyridine	25	0.81		1	2-Methoxypyridine	25	3 06	
21	2-Bromopyridine	25	0 90		81	2-Amino-7-nitronaphthalene	25	3 10	
22	2-Cyanoaniline	25	0 95			1,3-Dimethylpyrazole	25	3 11	
23	2,6-Dimethyl-4-nitroaniline	22	0 98		83	2-Methoxyquinoline	20	3 16	
24	4-Nitroaniline	25	1 00		84	3-Acetylpyridine	25	3 18	
25	N-Chlorodiethylamine	25	1 02		85	4-Hydroxypyridine	20	3 20	11 12
26	2-Methyl-4-nitroaniline	24 5	1 04		86	2-Fluoroaniline	25	3 20	
27	2-Bromoquinoline	25	1 05		87	1-Amino-4-bromonaphthalene	25	3 21	
28	Tris (2-cyanoethyl) amine	25	11		88	3-lodopyridine	25	3 25	
29	Pyrimidine	20	1 23		89	1-Amino-3-methoxynaphthalene	25	3 26	
		} :	(1 31)		90	1-Amino-3-hydroxynaphthalene	25	3 30	
30	2-Amino-3-nitronaphthalene	25	1 48		91	1-Amino-5-chloronaphthalene	25	3 34	
31	3-Methyl-4-nitroaniline	25	1 50		92	2-Amino-4-chloronaphthalene	25	3 38	
32	2,5-Dichloroaniline	22	1 57		93	4-Aminofluorene	25	3 39	
33	4-Cyanoaniline	25	1 74		94	2-Amino-4-bromonaphthalene	25	3 40	
34	4-Cyano-N,N-dimethyl aniline	25	1 78 1 82		95	2-Amino-4-iodonaphthalene	25	3 41 3 48	
35 36	2-Iodopyridine 2,3-Dimethyl-4-nitroaniline	25 25	1 96		96 97	1-Amino-7-chloronaphthalene	25 25	3 48	
37	2,4-Dichloroaniline	25	2 00		98	1-Amino-6-chloronaphthalene Oumazoline	20	3 49	
38	1-Amino-3-nitronaphthalene	25	2 07		99	3-Chloroaniline	25	3 52	!
39	3-Methoxy-5-nitroaniline	25	2 11		100		25	3 54	
40	4-Aminobenzophenone (4-Benzoylaniline)	25	2 17		I.	3-Methylpyrazole	25	3 56	
41	4-Aminoacetophenone (4-Acetylaniline)	25	2 19		1	3-Aminoa cetophenone (3-Acetylaniline)	25	3 56	ı
-	•		(2 75)		103	3-Fluoroaniline	25	3 57	
42	2-Aminoacetophenone (2-Acetylaniline)	25	2 22		104	4-Bromo-2-methylaniline	25	3 58	
43	Pyridazine	20	2 24		105	3-Bromoaniline	25	3 58	
44	1-Amino-3-cyanonaphthalene	25	2 26		1	2-(Methylthio)pyridine	20	3 59	!
45	Cinnoline	20	2 27		107	3-Iodoaniline	25	3 61	
46	1,2,4-Triazole	25	2 30		108	5-Bromoquinoline	25	3 62	
47	2,4-Dibromoaniline	15	2 3		109	1-(Methylamino)naphthalene	27	3 67	
	2,6-Dibromoaniline	25	2 34		l l	2-Amino-7-chloronaphthalene	23	3 71	!
49	7-Nitroquinoline	20	2 40		111	4-Bromopyridine	20	3 78	
50	2-Amino-4-nitronaphthalene	25	2 43		112	4-Iodoaniline	25	3 78	
51	Thiazole	20	2 44		113	2-Aminobiphenyl	22	3 82	
52	3-Nitroaniline	25	2 466		114	3,5-Dimethoxyaniline	25	3 82	
53	Pyrazole	25	2 48		115	4-Chloropyridine	20	3 84	
54	2-Bromoaniline	25	2 53		116	4-Bromoaniline	25	3 86	
55	1-Amino-7-nitronaphthalene	25	2 55		117	1-Aminofluorene	25	3 87	
56	8-Nitroquinoline	20	2 55		118	1-Amino-6-methoxynaphthalene	25	3 90	
5 <b>7</b> 58	3,5-Dimethyl-4-nitroaniline 2-Iodoaniline	25 25	2 59 2 60		119	1-Aminonaphthalene	25	3 92 3 95	
20	7-1000gmme	L <sup>23</sup>	2 00		120	2,6-Dimethylaniline	25	3 93	

(Listed in order of increasing pKa) (Continued)

121   8-Aminoquinoline   20   3 95   183   8-Methylquinoline   25   4 91   1-Amino-5-hydroxynaphthalene   25   3 96   184   3,5-Dimethylaniline   25   4 91   1-Amino-6-hydroxynaphthalene   25   3 97   186   3-Aminoquinoline   20   4 91   1-Amino-6-hydroxynaphthalene   25   4 00   187   4-tert-Butylaniline   25   4 95   126   3-(Methylthio)aniline   25   4 00   188   3,5-Di-tert-butylaniline   25   4 97   127   4-Iodopyridine   20   4 02   189   2-Vinylpyridine   25   4 98   128   2-Amino-4-methoxynaphthalene   25   4 07   191   N,3-Dimethylaniline   25   5 03   130   1-Amino-7-methoxynaphthalene   25   4 07   191   N,3-Dimethylaniline   25   5 03   132   1-Aminoanthracene   25   4 16   193   4-Methylaniline   25   5 08   195   4-Methylani	No	Name	T,°C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
122   1. Animo-5. hydroxynaphthalene					μκ.2	<b> </b> -		╀╌┤		PIC <sub>2</sub>
123   1.Amino-Arvitylaphthalene   25   3.96   185   3.Aminoquinoline   29   4.91    -1.4   1.Amino-Arvitylaphthalene   25   4.00   187   4-fert. Butylamiline   25   4.91    -1.4   1.Amino-Arvitylaphthalene   25   4.00   187   4-fert. Butylamiline   25   4.97    -1.4   1.Amino-Arvitylaphthalene   25   4.00   187   4-fert. Butylamiline   25   4.97    -1.4   1.Amino-Arvitylaphthalene   25   4.05   190   1.Amino-Breatene   25   4.98    -1.4   1.Amino-Arvitylaphthalene   25   4.07   191   1.Amino-Breatene   25   4.98    -1.4   1.Amino-Arvitylaphthalene   25   4.07   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.00    -1.4   1.Amino-Breatene   25   4.17   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   1.Amino-Breatene   25   5.10    -1.4   1.Amino-Breatene   25   4.10   191   191   191   191   191   19						11	l • •			
124   1.Amino-Abytosynaphtalene		, , ,	1			II	1	1 1		
125   A. Chocoanline						!!	<b>!</b>			
126   3.4 Methylthio janiline		, , , ,	1			li l				
120   1.00apyrtüne				i I	i	ii .	, ,			
2. Amino-d-methoxynaphthalene	,		, ,			IJ	I	1 1		
20	- 1	• •				11	1 7 7 7	)		2 41
		• -	25	4 07			I '			
132   A-minoanthracene		1-Amino-7-methoxynaphthalene	25	4 07		191	1 .	21	5 00	
3.3   A-minoaphthalene   25   4   16   194   A-Minohiline   25   6   107	131	3-Bromo-4-methoxyaniline	23	4 08		192	2-tert-Butylaniline	25	5 03	
134   A-Allylandline	132	1-Aminoanthracene	25	4 1		193	6-Methoxyquinoline	20	5 03	
153   3-Ethoxyaniline	133	2-Aminonaphthalene		4 16		194	N,N-Dimethylaniline	25	5 068	
1-  1-  1-  1-  1-  1-  1-  1-  1-  1-	•	•	1 1		'	195	4-Methylaniline	1 1		
3.7   3. Amino-7-methoxynaphthalene			í I			1)	1			8 60
138				-		!!	1			
39   3-Methoxyanitine		*	1 1			ll'	1 -	1 1		
A-minobipheny	- 1	· •				}	1 · ·		-	
14    4-Bromo-N,N-dimethylaniline   25   4.232   202   2-Amino-So.7,8-tetrahydronaphthalene   17   5.17   14.23   2-Amino-So.7,8-tetrahydronaphthalene   25   5.17   14.23   2-Amino-So.7,8-tetrahylaniline   25   5.17   14.25   2-Amino-So.7,8-tetrahylaniline   25   4.25   203   4-Dimethylaniline   25   5.17   2-Dimethylaniline   25   4.35   205   4-Methylquinoline   25   5.20   2-Dimethylaniline   25   4.35   205   4-Methylquinoline   25   5.25   2.25	- 1	· ·	1 1				' ' ' '	1 1		
3-Aminobipheny						II .	, .	1 1		
2-Aminor-Î-lydroxynaphthalene	- 1	•	1 1				· -			
144   2.3,5,6-Tetramethylaniline		- ·	1 1			IJ	, ,	1 1	_	
145		· · · · · · · · · · · · · · · · · · ·	1 1							
4-Methythio janiline		•	, ,							
148   Tris(2-chloroethyl)amine		•	25	4 35		206	Pyridine	25		
2-Ethylaniline	147	2-n-Propylaniline	25	4 36		207	Bis(2-cyanoethyl)amine	25	5 26	
150   2,4,6-Trimethylaniline	148	Tris(2-chloroethyl)amine	25	4 37		208	7-Methylquinoline	25	5 29	
151   3,5-Dimethylpyrazole	149	2-Ethylaniline		4 37		209	N-Cyclopentylaniline	25	5 30	
152   3-(Methylthio)pyridine   20   4 42   212   Aminoacetonitrile   25   5 34	150	2,4,6-Trimethylaniline	!!	4 37		210	5-Aminoindane	16	5 31	
153   2-Isopropylaniline						1	,			
154	- 1					1		1 1		
2-Ethoxyaniline							1			
156   2-Methylaniline	- 1	•	1 1			1	l '	1 1		
1-Amino-5,6,7,8-tetrahydronaphthalene		•	• •	- 1			<b>3</b> -	1	1	
Phenanthridine	- 1	·	1 6					i i		
2-Methoxyaniline		•	1 1					1 1	. 1	
160   2,5-Dimethylaniline			1 1				-	1 1		
1-	1	-	, ,	1		1 1		1 1	1	
Bis(2-Cyanoethyl) ethyl amine   25   4 55   223   6-Aminoquinoline   20   5 59     164   2-(Dimethylamino)naphthalene   25   4 566   224   N-Cyclohexylaniline   25   5 60     165   Aniline   25   4 603   225   4 403   225   4 603     166   5-Methylquinoline   25   4 62   226   N,N,4-Trimethylaniline   25   5 62     167   N,2-Dimethylaniline   23   4 62   227   3-Methylpyridine   25   5 63     168   2-Aminofluorene   25   4 64   228   4-Methylbenzimidazole   25   5 65     169   2-Amino-6-methoxynaphthalene   25   4 64   229   N,N-Di-n-propylaniline   23   5 68     170   4-Fluoroaniline   25   4 66   231   1-Isopropylaniline   25   5 71     171   3-tert-Butylaniline   25   4 70   233   2-tert-Butylpyridine   25   5 77     173   3-Methylaniline   25   4 70   233   3-tert-Butylpyridine   25   5 78     176   1,2-Diaminobenzene (o-Phenylenediamine)   25   4 70   235   3-tert-Butylpyridine   25   5 82     177   N-n-Propylaniline   25   4 79   237   2-Isopropylpyridine   25   5 82     178   Quinoline   25   4 82   239   2-tert-Butylpyridine   25   5 87     180   1-(Dimethylamino)naphthalene   28   4 83   240   2-Methylpyridine   25   5 94     181   N-Methylaniline   25   4 848   241   4-(Methylthio)pyridine   20   5 94     181   N-Methylaniline   25   4 848   241   4-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine   20   5 94     1-(Methylthio)pyridine	- 1		25	4 55			•	1 1		
Bis(2-Cyanoethyl) ethyl amine   25   4 55   224   6-Aminoquinoline   25   5 60	1		1 1	1		1	1	1	1	
165   Aniline	163	Bis(2-Cyanoethyl) ethyl amine	25	4 55		223	6-Aminoquinoline	20	5 59	
166   5-Methylquinoline   25   4 62   226   N,N,4-Trimethylaniline   25   5 627   167   N,2-Dimethylaniline   23   4 62   227   3-Methylpyridine   25   5 63   168   2-Aminofluorene   25   4 64   228   4-Methylbenzimidazole   25   5 65   169   2-Amino-6-methoxynaphthalene   25   4 64   229   N,N-Di-n-propylaniline   23   5 68   170   4-Fluoroaniline   25   4 65   230   2-Methylquinoline   25   5 69   171   3-tert-Butylaniline   25   4 66   231   1-Isopropylaniline   25   5 71   172   3-Isopropylaniline   25   4 67   232   3-Isopropylpyridine   25   5 72   173   3-Methylaniline   25   4 70   233   3-Isopropylpyridine   25   5 76   174   3-Methylaniline   25   4 70   234   N-Isopropylaniline   25   5 78   176   1,2-Diaminobenzene (o-Phenylenediamine)   25   4 74   0 6   236   3-tert-Butylpyridine   25   5 82   177   N-n-Propylaniline   25   4 81   238   4-Ethylpyridine   25   5 89   1-(Dimethylamino)naphthalene   28   4 83   240   2-Methylpyridine   25   5 94   181   N-Methylaniline   25   4 848   241   4-(Methylthio)pyridine   20   5 94   1-(Methylthio)pyridine   20							- · · · · · · · · · · · · · · · · · · ·	1 1	í	
167	1		1 1	,		1		1 1		
2-Aminofluorene	- 1	· •					•	1		
2-Amino-6-methoxynaphthalene		· ·	1 1	1						
4-Fluoroaniline						l I	•			
171   3-tert-Butylaniline   25   4 66   231   1-Isopropylbenzimidazole   25   5 71     172   3-Isopropylaniline   25   4 67   232   3-Isopropylpyridine   25   5 72     173   2,3-Dimethylaniline   25   4 70   233   2-tert-Butylpyridine   25   5 76     174   3-Methylaniline   25   4 70   234   N-Isopropylaniline   25   5 77     175   3-Ethylaniline   25   4 70   235   5-Methylbenzimidazole   25   5 78     176   1,2-Diaminobenzene (o-Phenylenediamine)   25   4 74   0 6   236   3-tert-Butylpyridine   25   5 82     177   N-n-Propylaniline   25   4 79   237   2-Isopropylpyridine   25   5 83     178   Quinoline   25   4 81   238   4-Ethylpyridine   25   5 87     179   3-Aminofluorene   25   4 82   239   2-Ethylpyridine   25   5 89     180   1-(Dimethylamino)naphthalene   28   4 83   240   2-Methylpyridine   25   5 94     181   N-Methylaniline   25   4 848   241   4-(Methylthio)pyridine   20   5 94     197   197   197   197   197   197   197   197     198   199		· -	1 1	1				i f		
3-Isopropylaniline		· · · · · · · · · · · · · · · · · · ·					•	1 1		
2.3-Dimethylaniline			1 1	1	1		- ••	1 1		
3-Methylaniline		• ••	I F	- 1		4 1		1 1		
3-Ethylaniline		=	1 1					1 1		
176       1,2-Diaminobenzene (o-Phenylenediamine)       25       4 74       0 6       236       3-tert-Butylpyridine       25       5 82         177       N-n-Propylaniline       25       4 79       237       2-Isopropylpyridine       25       5 83         178       Quinoline       25       4 81       238       4-Ethylpyridine       25       5 87         179       3-Aminofluorene       25       4 82       239       2-Ethylpyridine       25       5 89         180       1-(Dimethylamino)naphthalene       28       4 83       240       2-Methylpyridine       25       5 94         181       N-Methylaniline       25       4 848       241       4-(Methylthio)pyridine       20       5 94		· · · · · · · · · · · · · · · · · · ·							1	
177         N-n-Propylaniline         25         4 79         237         2-Isopropylpyridine         25         5 83           178         Quinoline         25         4 81         238         4-Ethylpyridine         25         5 87           179         3-Aminofluorene         25         4 82         239         2-Ethylpyridine         25         5 89           180         1-(Dimethylamino)naphthalene         28         4 83         240         2-Methylpyridine         25         5 94           181         N-Methylaniline         25         4 848         241         4-(Methylthio)pyridine         20         5 94		*			06					
178 Quinoline     25     4 81     238     4-Ethylpyridine     25     5 87       179 3-Aminofluorene     25     4 82     239     2-Ethylpyridine     25     5 89       180 1-(Dimethylamino)naphthalene     28     4 83     240     2-Methylpyridine     25     5 94       181 N-Methylaniline     25     4 848     241     4-(Methylthio)pyridine     20     5 94		` ` ` '	. 1	t t				, ,		
180         1-(Dimethylamino)naphthalene         28         4 83         240         2-Methylpyridine         25         5 94           181         N-Methylaniline         25         4 848         241         4-(Methylthio)pyridine         20         5 94	178	Quinoline	25	4 81		238	4-Ethylpyridine		5 87	
181 N-Methylaniline   25   4 848   241   4-(Methylthio)pyridine   20   5 94				1		1 1	· • •		- 1	
	- 1						7 7 7	1 1		
182 <b>Z,4-Dimethylaniline</b>   25   4.89     242   <b>2-Hexylpyridine</b>   25   5.95		•		- 1	- 1	1 1			r	
<del></del>	182	2,4-Dimethylaniline	25	4 89		242	2-Hexylpyridine	25	5 95	

(Listed in order of increasing pKa) (Continued)

No	Name	T °C	pK <sub>1</sub>	pK,	No	Name	T °C	pK,	pK <sub>2</sub>
	2 - Decemberaldi	25	5 97		#	Dia/2 hudroughhul) amina	25	· · · · · · · · · · · · · · · · · · ·	
243	2-n-Propylpyridine	25	5 99		305	Bis(2-hydroxyethyl)amine	25	8 88	1
244 245	4-tert-Butylpyridine	25	6 00		306 307	1	21	891	ì
243	2-Pentylpyridine	25	6 02		11	• • •	30	8 93	5 85
	4-Isopropylpyridine	25	6 03		308	•		8 97 9 08	) 83
247 248	4-Methylpyridine	25	6 03		309	1-(Aminoethyl)benzene	25	91	l
249	3-Aminopyridine N,N,2-Trimethylaniline	25	611		310	, , ,	25	9114	
250	=	25	612		311	4-Aminopyridine	20	9114	
230	N,2,6-Trimethylaniline	23	0 12		312	· ·		t -	1
252	2 Mathulhansimidasala	25	6 19		313	1	25 25	9 13 9 15	ŀ
252 253	2-Methylbenzimidazole 1,4-Diaminobenzene (p-Phenylenediamine)	25	62	2 67	314 315	, ,	25	919	İ
254	2-lsopropylbenzimidazole	25	621	201	316	1 , ,	22 5	9 19	ļ
	2-Ethylbenzimidazole	25	6 27		317	trans-1-Amino-2-hydroxycyclopentane	25	9 28	
	N,N-Di-n-butylaniline	19	6 30		318	Diallylamine	25	9 29	
	2,5-Dimethylpyridine	25	6 40		319	•	20	931	ļ
	2-Phenylimidazole	25	6 40		320	Dimethyl (2-hydroxyethyl) amine 3-Methylbenzylamine	25	9 33	
	Bis(2-chloroethyl)methyl amine	25	6 43		321	Benzylamine	25	9 35,	
260	4-Methoxyquinoline	30	6 45		321	Benzylamine	[23]	(9 62)	
261	3,4-Dimethylpyridine	25	6 46		322	4-Methylbenzylamine	25	9 36	1
262	4-Methoxypyridine	25	6 47		11	3,4-Dimethoxybenzylamine	25	9 39	
263	Bis(2-chloroethyl) ethyl amine	25	6 55	i	!!	2,3-Dimethoxybenzylamine	25	941	1
264	1,2-Dimethylbenzimidazole	25	6 55		II	2-(Phenethylamino)ethylamine	25	9 44	6 59
	2,3-Dimethylpyridine	25	6 57		11	N,N-Diethylbenzylamine	25	9 44	
	2,6-Dimethylpyridine	25	6 60	•	327	· · · · · · · · · · · · · · · · · · ·	25	9 47	
267	7-Aminoquinoline	20	6 61		328	, ,	20	9 49	
268	N,N-Diethylaniline	22	6 61		11	2-Hydroxyethylamine	25	9 498	
269	4-Ethoxypyridine	20	6 67			2-(Dimethylamino)ethylamine	25	9 53	6 63
270	2-Aminopyridine	25	671		331		25	9 54	
271	2,4-Dimethylpyridine	25	6 77		11	1,2-Bis(diethylamino)ethane	25	9 55	6 18
272	Imidazole	25	6 95		11	2-Aminoindane	21 5	9 57	ŀ
273	N-tert-Butylaniline	25	7 00		334		25	9 58	}
	(2-Cyanoethyl) dimethyl amine	29	7 0		335	• •	20	9 59	7 95,
275	2-Benzyl-2-pyrroline	25	7 06						pK <sub>3</sub> =
276	2-Aminoquinoline	20	7 30		\\		1 1		3 72
277	N,N-Di-isopropylanılıne	25	7 37		336	2-Methoxyethylamine	20	9 61	j
278	N-Methylmorpholine	25	7 38		337	5-Bromo-n-pentylamine	21	9 62	
279	2,4,6-Trimethylpyridine	25	7 43		338	trans-1-Amino-2-hydroxycyclohexane	25	9 63	1
280	4-Methylimidazole	25	7 518		339	1-Amino-1,2,3,4-tetrahydronaphthalene	20	9 63	İ
281	1,3-Triazine	25	76		340	N-Ethylbenzylamine	25	9 64	İ
282	N-Ethylmorpholine	25	7 67		341	3,3,3-Trichloro-n-propylamine	20	9 65	<u> </u>
	2-Cyanoethylamine	29	77			1-Allylpiperidine	25	9 65	ļ
284	Tris(2-hydroxyethyl)amine	25	7 762		11	2-Methoxybenzylamine	25	9 70	}
285	2-Methylimidazole	25	7 85		11	cis-1-Amino-2-hydroxycyclopentane	25	9 70	
286	N-Methylaziridine	25	7 86	İ		2-(Furfurylamino)ethylamine	20	9 72	6 20
287	N-n-Butylaziridine	25	7 86		346	cis-1-Amino-2-hydroxycyclohexane	25	9 72	
	2-Ethyl-2-pyrroline	25	7 87		347	Piperazine	25	9 81	5 55
	2,3,5,6-Tetramethylpyridine	20	7 90			Trimethylamine	25	981	
	2-Cyclohexyl-2-pyrroline	25	7 91	İ	349	Phenethylamine ((2-Aminoethyl)benzene)	25	9 84	
	N-Ethylaziridine	24	7 93		1	Diethyl 2-hydroxyethyl amine	20	9 87	
292	Aziridine	25	8 01		351		25	9 88	( 040
293	N,2-Diethylaziridine	25	8 18			1,2-Diaminoethane (1,2-Ethylenediamine)	25	9 928	6 848
294	2-Ethylaziridine	25	8 29		I I	cis-1,2-Diaminocyclohexane	20	9 93	6 13
295	Triallylamine	25	8 31			2-Amino-1,2,3,4-tetrahydronaphthalene	17	9 93	
296	Morpholine	25	8 33			Tri-n-butylamine	25	9 93	
297	2,4-Dimethylimidazole	25	8 36		356		20	9 93	4 47
	2-Bromoethylamine	24	8 49		357		20	9 94 9 96	6 47
	Bis(2-hydroxyethyl) methyl amine 1.2-Bis(furfurvlamino)ethane	25 20	8 52 8 61	5 74		3-Hydroxypropylamine meso-2,3-Diaminobutane	25 25	9 96	6 92
1	2,2-Dimethylaziridine	25	8 61 8 64	5 14		d.l-2.3-Diaminobutane	25	10 00	691
	trans-2,3-Dimethylaziridine	23	8 69		361	1,2-Diaminopurane	25	10 00	7 13
	cis-2,3-Dimethylaziridine	23	8 72		] 301	(1,2-Propylenediamine)	2	10.00	, 13
	(2-Chloroethyl) diethyl amine	25	8 80		362	cis-Neobornylamine	25	10 01	
304	(2-Curoroethyr) diethyr annie	لــــــــــــــــــــــــــــــــــــــ	0 00		1. 302	elo i recooting tannine	127	10 01	<u> </u>

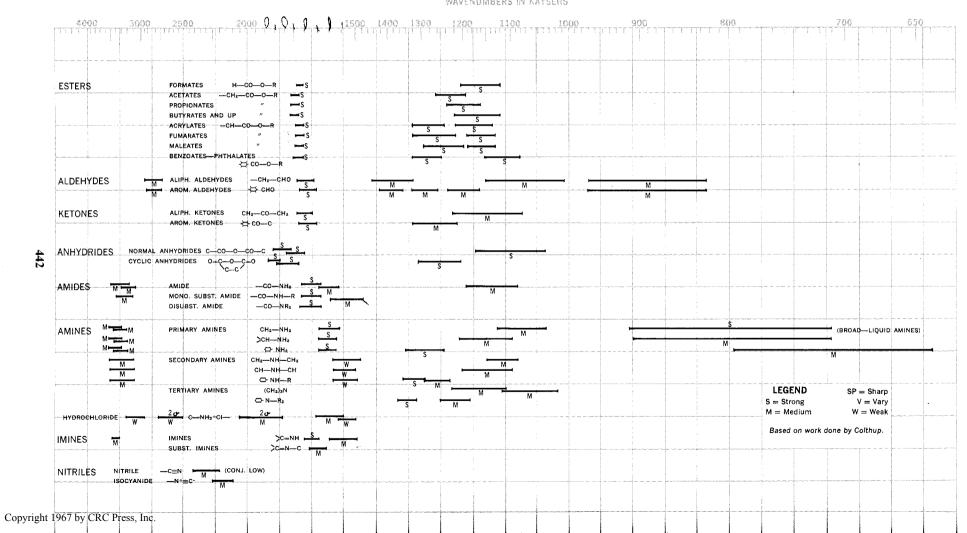
(Listed in order of increasing pKa) (Continued)

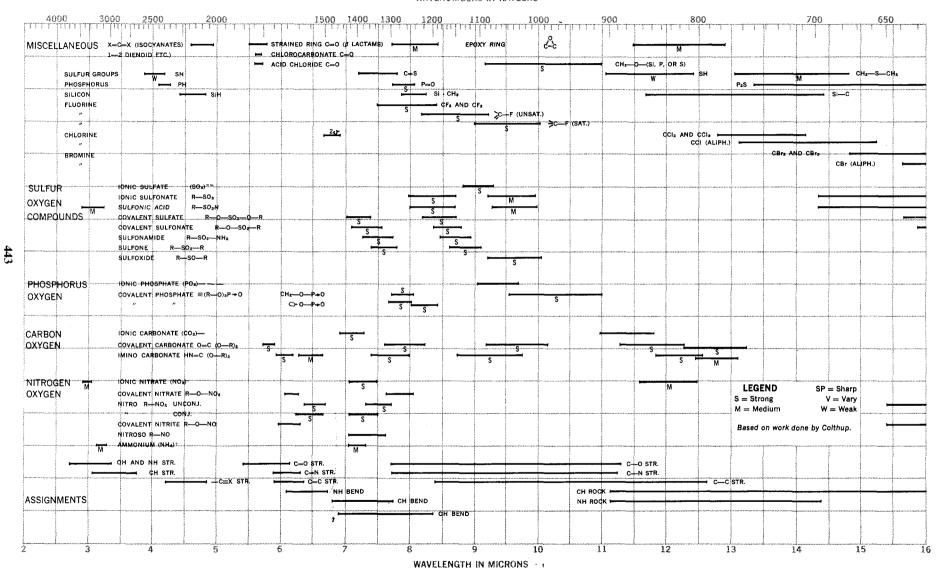
No	Name	T °C	рK,	pK 2	No	Name	T,°C	pK,	pK <sub>2</sub>
363	2-(Piethylamino)ethylamine	25	10 02	7 07	417	n-Pentylamine	25	10 63	
364	1-Methylpiperidine	25	10 08		418	n-Undecylamine (n-Hendecylamine)	25	10 63	ı
365	Dimethyl isobutyl amine	20	10 08		419		25	10 64	
366	5,5,5-Trichloro-n-pentylamine	20	10 12		420	Acridine	25	10 65	
367	2-(Methylamino)ethylamine	20	10 15	6 86	421	n-Octylamine	25	10 65	
368	cis-1,2,6-Trimethylpiperidine	30	10 15		422	•	25	10 657	
369	2,2-Dimethyl-n-propylamine	25	10 15		423		25	10 66	I
370	1,2-Bis(methylamino)ethane	25	10 16	7 40	424		25	10 66	
371	Dimethyl propyl amine	20	10 16		425		,5	10 67	ı
372	Dimethyl ethyl amine	20	10 16	l i	426	•	25	10 68	
373	trans-Bornylamine	25	10 17		427	tert-Butylamine	25	10 68	
374	1,2,2,4-Tetramethylpiperidine	30	10 18		428	-	20	10 69	
375	n-Butyl dimethyl amine	25	10 19	ł	429	n-Propylamine	25	10 69	
376	1,2-Dimethylpyrrolidine	26	10 20	)	430	, •	30	10 70	
377	1,2-Dimethylpiperidine	25	10 22	l i	431	Ethylamine	25	10 70	
378	1,5-Diaminopentane	25	10 25	9 13	432		25	10 72	
379	Tri-n-propylamine	25	10 26	' '	433		25	10 73	
380	1,2-Bis(propylamino)ethane	25	10 27	7 53	434		25	10 73	!
381	2-(Butylamino)ethylamine	25	10 30	7 53	435	•	25	10 75	
	1,3-Diaminopropane	25	10 30	8 29	1	2-Cyclohexylpyrrolidine	25	10 76	l
302	(1,3-Propylenediamine)	123	10 30	027	437		20	10 80	9 35
383	2-Benzylpyrrolidine	25	10 31		438	Di-isobutylamine	21	10 91	, , , , ,
384	Tri-isobutylamine	25	10 31		439	1,6-Diaminohexane	25	10 91	9 83
385	N-Methylpyrrolidine	25	10 32		440	Di-isoamylamine	27 8	10 93	765
386	2-(propylamino)ethylamine	25	10 32	7 54	440	•	25	10 94	
387	4-Hydroxy-n-butylamine	20	10 34	, 54	1	Quinuclidine  2 Mathylpinosidina	25	10 95	
388	1,2-Bis(isopropylamino)ethane	25	10 40	7 59		2-Methylpiperidine 2-(Trimethylsilyl)ethylamine	25	10 93	
389	1-n-Propylpiperidine	26 5	10 40	1 39	1	Di-n-tridecylamine	25	11 00	
390	3-Aminopentane	25	10 41		444		25	11 00	
	3-Aminopentane 3-Aminocyclohexene	25	10 42		445	·	20	11 00	10 1
392	1-n-Butylpiperidine	26	10 42				25'	11 00	10 1
393	1-Resputyipperiume 1-Ethylpiperiume	23	10 45		447	Di-n-propylamine	25	11 00	
394	1,2-Bis(ethylamino)ethane	25	10 45	7 70	448 449	Di-n-dodecylamine	25	11 00	
		20	10 46	/ /0		Di-n-pentadecylamine	25	11 00	
393	Diethyl methyl amine	23	10 46		450	Di-n-hexylamine	1 1	11 01	
397	5-Hydroxy-1-pentylamine	20	10 40		451	Di-n-octylamine	$\begin{vmatrix} 25 \\ 30 \end{vmatrix}$	11 04	
398	Dimethyl isopropyl amine	25	10 47		452	2,2,4-Trimethylpiperidine	25	11 04	
	trans-1-Amino-4-methylcyclohexane				453	Cyclohexyl methyl amine	1 1		
399 400	(Aminomethyl)cyclohexane cis-1-Amino-2-methylcyclohexane	25	10 49 10 49		454	Diethylamine	25	11 04	
	2-Amino-2-methylcyclonexane	25	10 49		455	2,2,6,6-Tetramethylpiperidine	25	-	
- 1		25	10 49		456	·	25	11 07	
- 1	trans-1-Amino-2-methylcyclohexane cis-1-Amino-3-methylcyclohexane		10 56		457	cis-2,6-Dimethylpiperidine	25	11 07	
- 1		25		74,	458	3-Methylpiperidine	25	11 07	
	2-(Ethylamino)ethylamine	25	10 56	7 63	459	Piperidine	25	11 123	
- 1	Dimethyl sec-butyl amine	20	10 57		460	Di-isopropylamine	21	11 13	
	6-Hydroxy-n-hexylamine	21	10 60		461	Di-n-pentylamine	26	11 16	
	6-Bromo-n-hexylamine	21	10 60		1	2,2,6-Trimethylpiperidine	30	11 21	
408	1-Aminoheptadecane	25	10 60		463		25	11 23	
	1-Aminodocosane	25	10 60			Di-n-butylamine	25	11 25	
	1-Aminooctadecane	25	10 60			1,2,2,4,4-Pentamethylpiperidine	25	11 25	
	1-Aminopentadecane	25	10 61		1	Pyrrolidine	25	11 27	
	n-Butylamine	25	10 61		467	Azetidine	25	11 29	
	1-Aminohexadecane	25	10 61		468	Isopropylamine	25	11 54,	
- 1	trans-1-Amino-3-methylcyclohexane	25	10 61					(10 63)	
	1-Aminotetradecane	25	10 62	<u>-</u> _		1,2-Dimethyl-2-pyrroline	25	11 90	
416	2-(Isopropylamino)ethylamine	25	10 62	7 70	470	Acetamidine (Methylamidine)	25	12 40	

Handbook of tables for Organic Compound Identification, © 1967 CRC

#### INFRARED CORRELATION CHART No. 1 (Con't.)

WAVENUMBERS IN KAYSERS





Prepared from information supplied by Beckman Instruments

This chart presents some information regarding structure, double-bond vibrations, hydrogen stretching and triple-bond vibrations.

HYDROGEN STRETCHING AND TRIPLE-BOND VIBRATIONS, 3750-2000 CM.-1

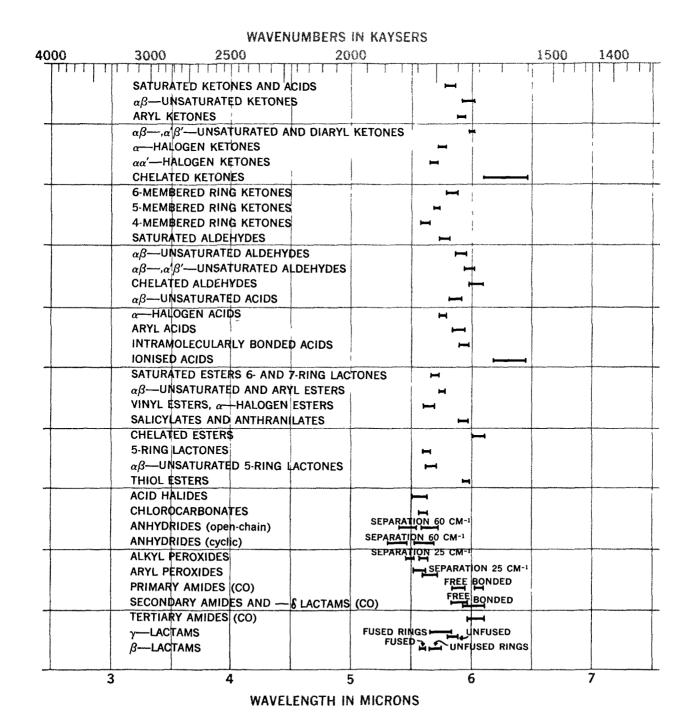
DOUBLE-BOND VIBRATIONS, ETC. 2000-1500 CM.-1

	1	5000 4000		AVENUMBERS			0 1400 1300 1200
	CH <sub>3</sub>		S S S		M		ALLENES
	CH		22			<u>, V</u>	—CH=CH₂
	СН		M		ļ <u>™</u>	+	>C=CH₂
	CH⊨CH		MM			₩.	C C
	CH⊨CH <sub>2</sub>		<u> </u>			<u>_S</u>	C≔C (conjugated)
	>C=CH₂	digital district	vi 🖁	<u> </u>		_M_ M	AROMATIC (all types of substitutio
	CH≡CR	W		, <b>i</b>	İ	<u>M</u> <u>M</u>	except as below)
	RC≣CR¹ CHO		2 BANDS(S)			1	AROMATIC (para- and unsymmetric trisubstitution)
	AROMATIC CH		M		CHARACTERIST BAND PATTER FOR VARIOUS OF SUBSTITUT	ic M M	AROMATIC (vicinal trisubstitution)
	COOH	(MONOMER) M	W BROAD I	IMER	FOR VARIOUS	TYPES SM V	AROMATIC (conjugated)
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	FREE (V)	LYMERS (S)		OF SUBSTITUT	ION .	AROMATIC (all types)
444	C≣O	SINGLE BRI	DGE (V) NCHELATE	s (w) M		+	C⊨N
-	NH₂	FREE 2 BANDS (M	BONDED (S)	-	ļ	- V	C=N (conjugated or cyclic)
	NH	FREE BAND (M)	<del>-</del> 1			BONDED (S)	N and N
	=NH	FREE	(M) BONDED (S)			FREE (S) BONDED	CONH <sub>2</sub> (see chart 4 for CO) CONH (open-chains only) NH <sub>2</sub>
	CONH₂	14 Mb	M PONDED (M)		-	S FREE (S)	CONH (open-chains only)
	CONH (open-chain)	FRE	<b>⊢</b> ⊢ ⊢ ⊢				14112
	CONH (lactams)	FREE				w s	NH
	NH₃+RCOOH		M (W) MOS	BAND SERIES V		w	NH <sub>3</sub> <sup>+</sup>
	NH₄+CLRCOOH	MAN	M CONTINUOUS	BAND SERIES	4	S	NH₄+CLR
	NH₂ RCOO—X+	MM	M	Ten (, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, ) (1, )			- COO-
	PYRIDINE, Etc.		Maria de la companya della companya della companya de la companya de la companya della companya		ļ	S	C—NO <sub>2</sub> O—NO <sub>2</sub>
	AZIDES			<u>S</u>		S	N—NO <sub>2</sub>
	C≡N					_3_	
	αβ—UNSATURATE	D NITRILES	armed and the same of the same	ă v		M M	PYRIDINE, Etc.
	C≣N—			_M_ —		M	PYRIMIDINE, Etc.
	P—H NH <sup>1</sup>		_VS_			<u>M</u> <u>M</u>	TROPOLONES
	CN, OCN, Etc.			s			
	POH		_ <u>w_</u>		1		The state of the s
	SH		<u> </u>		LEGEND	SP = Shar	n
	Si H	CARLO CONTRACTOR CONTR		vs	S = Stro	ng V = Var	r y Based on work done by Bellamy.
ppyrigḥt 1967 by CRC Press,		2	<u> </u>		M = Med	dium W = Wea	

#### INFRARED CORRELATION CHART No. 3

Prepared from information supplied by Beckman Instruments

This chart presents some correlations between structure and the carbonyl vibrations of some classes of organic compounds. In all cases the absorption bands are strong and fall within the range of 1900-1500 cm<sup>-1</sup>

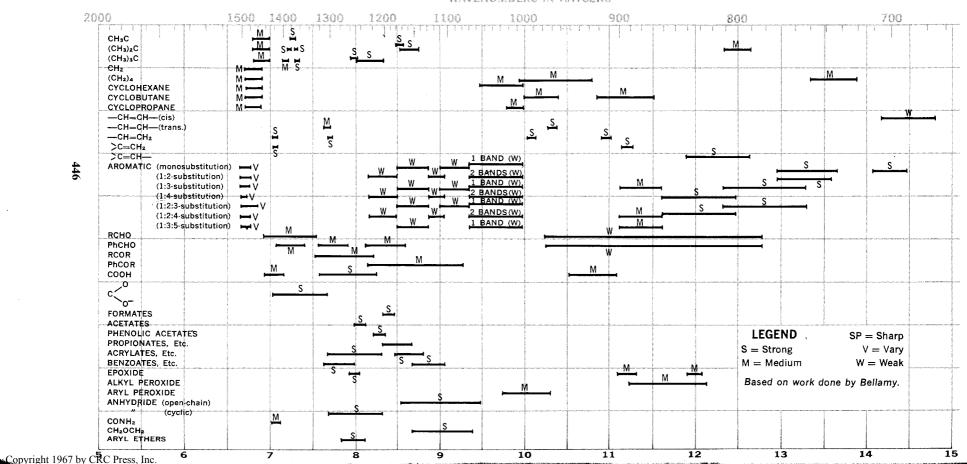


### INFRARED CORRELATION CHART No. 4

Prepared from information supplied by Beckman Instruments

This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650 cm<sup>-1</sup>.

#### WAVENUMBERS IN KAYSERS

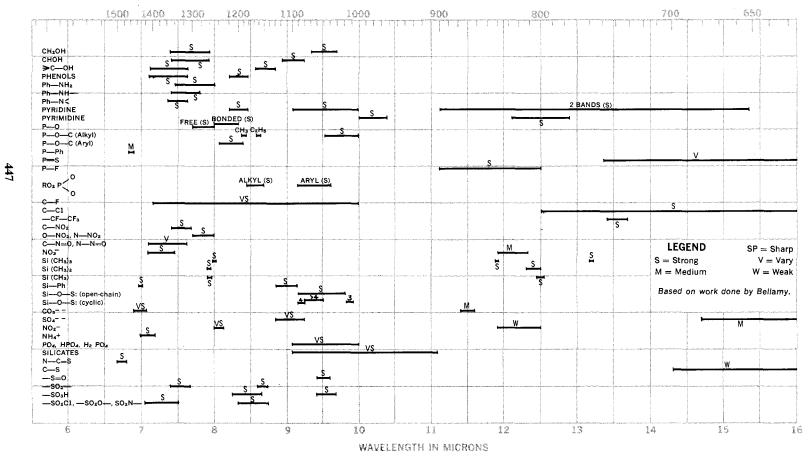


### **INFRARED CORRELATION CHART No. 4 (Con't.)**

Prepared from information supplied by Beckman Instruments

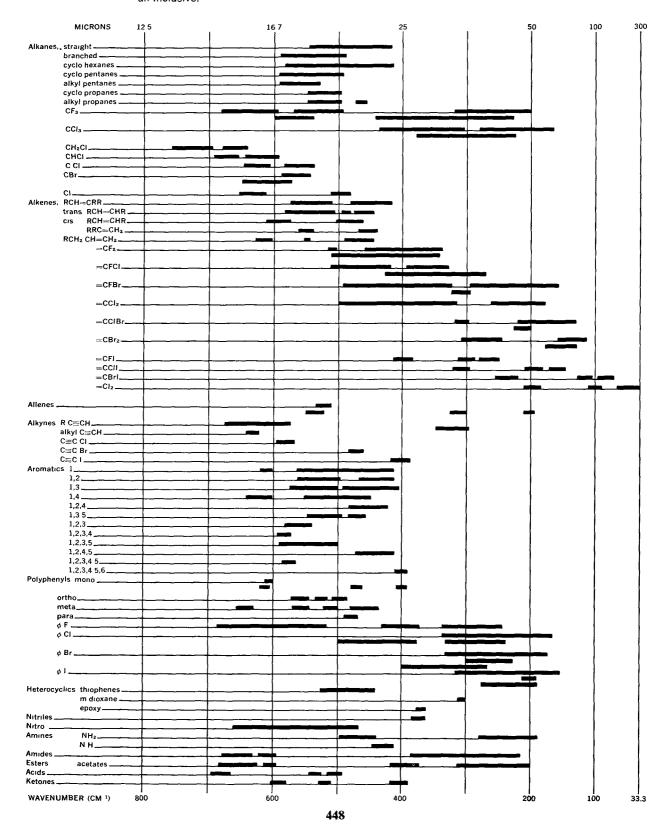
This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650 cm<sup>-1</sup>.

### WAVENUMBERS IN KAYSERS

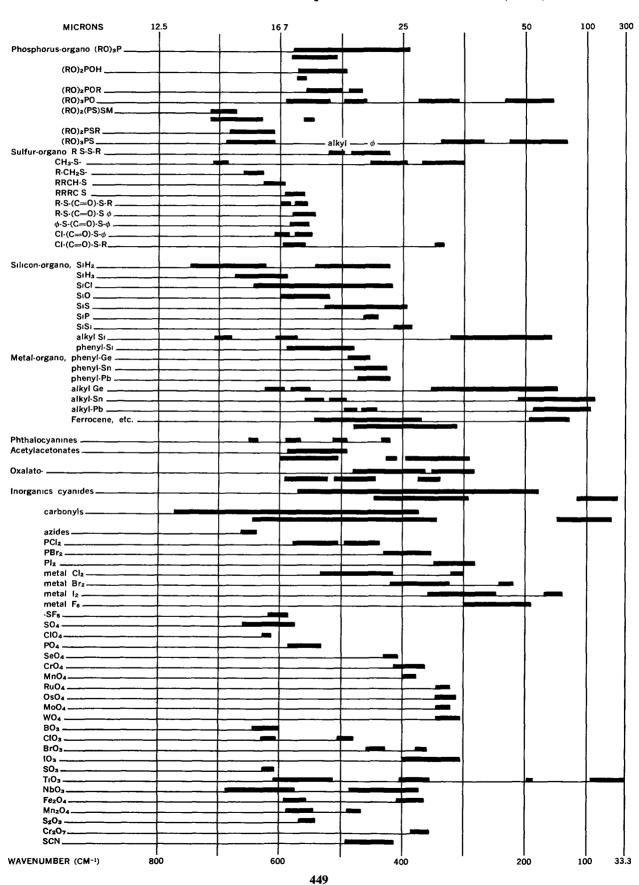


### FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART

Based on evidence compiled by James E. Stewart of Beckman Instruments. This chart shows the vibrational frequency correlation in the far infrared region. Because research is continuing in the far infrared region, this chart is not all-inclusive.



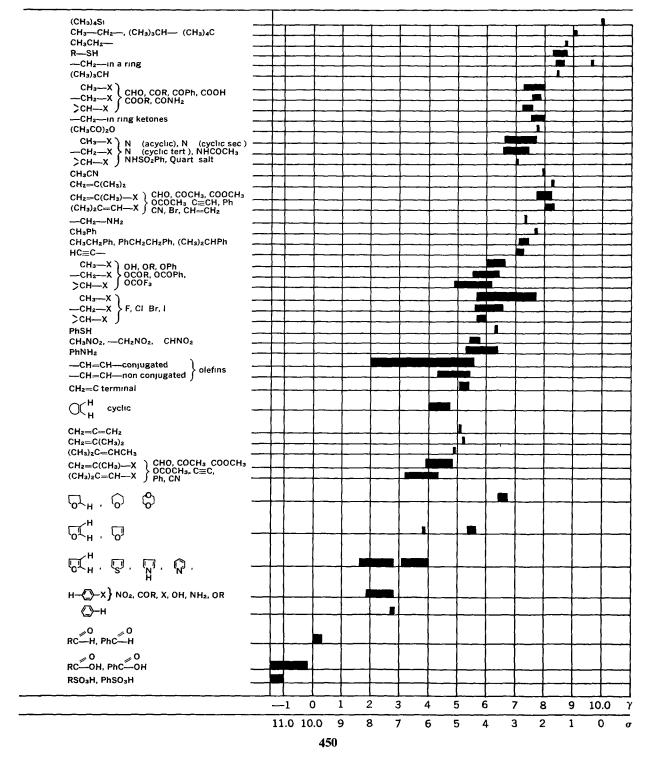
### FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART (Con't.)



# CHARACTERISTIC NMR SPECTRAL POSITIONS FOR HYDROGEN IN ORGANIC STRUCTURES

By permission from Erno Mohacsi, J. of Chemical Education, 41, 38 (1964)

This table is useful for quick qualitative determination of proton spectrum lines by providing a tabulation of line positions obtained using tetramethylsilane as an internal reference. The listing has been kept as simple as possible for this purpose. The proton spectrum lines are arranged according to the chemical shift relative to tetramethylsilane and are given in values of  $\tau$  and  $\sigma$ . The purpose of this table is to supplement tables available in standard references and to summarize information available in the literature.



# MISCIBILITY OF ORGANIC SOLVENT PAIRS Table A

Doctor J. S. Drury

Industrial and Engineering Chemistry

Vol. 44, No. 11, Nov. 1952

#### (Reprinted by permission)

The classifications were made by shaking together 5 ml. of each of the solvents listed in a test tube for 1 minute, then allowing the mixture to settle. If no interfacial meniscus was observed, the solvent pair was considered miscible. If such a meniscus was present, the solvent pair was regarded as immiscible. The classification of immiscible is a qualitative one since solvent pairs may exhibit some degree of partial miscibility while existing as separate phases. Solvent pairs possessing a pronounced degree of partial miscibility are designated by the symbol Is.

Compound number	Compounds	Acetone	Acetyl acetone	2-Amino-2-methyl-1- propanol	Aniline	Benzaldehyde	Benzene	Benzin	Benzyl alcohol	Butyl acetate	Butyl alcohol	n-Butyl ether	Capryl alcohol	Carbon tetrachioride	Diacetone alcohol	Diethanolamine	Diethyl cellosolve	Diethyl ether	Dimethylaniline	Ethyl alcohol	Ethyl benzoate	Ethylene glycol	2-Ethylhexanol	Formamide	Furfuryl alcohol	Glycerol	Hydroxyethyl- ethylenediamine	Isoamyl alcohol	Methyl isobutyl ketone	Nitromethane	Dibutoxytetra- ethylene glycol	Pyridine	Triethanolamine	Trimethylene glycol
1 2 3	Acetone Acetyl acetone Adiponitrile 2-Amino-2-methyl-	M M	M M	M R M	M	M	M	M M	M	M M M	M	M M I	M M		M M M	R	M M M	M	M	M	M M M	М	M	M	M M M	I	M R M	M M I	M M M	M M	M M M	M M M	 M	M M M
5 6 6 7 7 8 9 100 111 122 133 144 15 16 17 18 19 200 211 222 23 24 25 26 27 28 30 31	1-propanol Benzaldehyde Benzene Benzin Benzonitrile Benzothiazole Benzyl alcohol Benzyl mercaptan Butyl acetate Butyl alcohol n-Butyl ether Capryl alcohol Carbon tetrachloride Diacetone alcohol Diethanolamine Diethyl Cellosolve Diethyl ether Dimethylaniline Di-N-propylaniline Ethyl alcohol Ethyl benzoate Ethyl isothiocyanate Ethyl thiocyanate Ethylene glycol 2-Ethylhexanol Formamide	M M M M M M M M M M M M M M M M M M M	M M R M M M M M M M M M M M	M M I M M M M M M M M M		M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	I I I M I M I I I I I I I I I I I I I I	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	IS I M I M I I S M I I M I I M I I M I I M I I I M I I I I M I I I M I I I M I I I M I I I M I I I I M I I I I M I I I I M I	M M M M M M M M M M M M M M M M M M M	MIIIIMMIIIIMMIIIIMMIIIIMMIIIIMMIIIIMMIIII	M I M I M I M I M I M I M I M I M I M I	Is I I I I I I I I I I I I I I I I I I	R M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M I M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M M M M M M M M M M M M M M M M M M M	M I M M	M I Is M I M M M I I I M I I I I I I I I
33 34 35 36	ethylenediamine Isoamyl alcohol Isoamyl sulfide Isobutyl mercaptan Methyl disulfide	M M M M	M M M		M M M	M		M	M M		M M	M M M	M M · · ·	M M M	R M I M M	M	M M M	M M	M M M	M M M	M M M M M	M   ]		M I	ИΙ		M I I	M M		M	M M M M	M M M M	I R	M M I R R
38	Methyl isobutyl ketone Nitromethane Dibutoxytetra-	M M		M M		M M		M M					M Is		M M						M M		M I		M I		M M	M M		М	M M	M M		I I
40 41	ethylene glycol Pyridine Tri-n-butylamine Trimethylene glycol	M	M M	M M I M	i I	M M M	M M	M	M M		M M	M 1 M .	M	M		M	M M	M M	M M	M M	M I M I M I Is	M ] [  ]	M I M I	M	M I M I	M	M	M	M I	M		M M M		M M I

# MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)

Tables B and C W. M. Jackson and J. S. Drury

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The classifications were made at 20°C in the following manner. One milliliter portions of each solvent comprising a pair were shaken together for approximately a minute. If no interfacial meniscus was observed after the contents of the tube were allowed to settle the solvent pair was considered to be miscible, M. If a meniscus was observed without apparent change the volume of either solvent the pair was regarded as immiscible, I. This classification is a qualitative one since solvent pairs may exhibit various degrees of partial miscibility while existing as separate phases. If an obvious change occurred in the volume of each solvent but a meniscus was present, the pair was classified as partially miscible, S. The designation R indicates that the two solvents reacted

Table B

Compound number	Compound <b>s</b>	Acetone	Isoamyl acetate	n-Amyl cyanide	Benzene	Benzyl ether	2-Bromoethyl acetate	Cinnamaldehyde	Di-n-amylanine	Di-n butyl earbonate	Diethylacetic acid	Diethylenetriamine	Diethyl formamide	Dusobutyl ketone	Dusopropylamine	Di-n-propyl aniline	Ethyl alcohol	Ethyl benzoate	Ethyl ether	Ethyl phenylacetate	Heptadecanol	3-Heptanol	n-Heptyl acetate	n-Hexyl ether	Methyl 18opropyl ketone	4-Methyl n-valeric acid	o-Phenetidine	Sulfuric acid (concd)	Tetradecanol 4	Tri-n-butyl phosphate	Triethylene glycol	Triethylenetetramine	2,6,8-Trimethyl 4-nonanone	Compound number
1 2 2 3 3 4 4 5 5 6 7 7 8 9 100 111 12 133 14 4 15 166 17 7 18 19 200 221 223 224 25 266 27 7 28 29 300 31 32 33	Chloroform Cinnamaldehyde Di-n-amylamine Di-n-butyl carbonate Diethylacetic acid Diethylenetriamine Diethylacetic acid Diethylenetriamine Diethyl formamide Disobutyl ketone Disopropylamine Di-n-propylamine Ethyl alcohol Ethyl benzoate Ethyl benzoate Ethyl phenylacetate Heptadecanol 3-Heptanol n-Heptyl acetate n-Hexyl ether Methyl isopropyl keton 4-Methyl-n-valenc acid o-Phenetidine Sulfuric acid (concd) Tetradecanol Tri-n-butyl phosphate Triethylene glycol Triethylene glycol	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	M MM MM MM MM MM MM MM MM MM MM MM MM M	M M M M M M M M M M M M M M M M M M M	MM SI MM SI MM MM MM MM MM MM MM MM MM MM MM MM MM	MM MM MM MM MM MM MM MM MM MM MM MM MM	I MM I MM I MM I MM I MM I MM I MM I M	MMMRMM MRIRMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMRMRIMR RMMMMMMMMRIRRMMMMM	MMRMMR MRMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	M M M M M M M M M M M M M M M M M M M	MMMMRMRMRM MMMMMMMMRMRMRMMMMMMMMMMMMMM	M M M M M M M M M M M M M M M M M M M	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	M	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	RRRIRRIRRRRRRRRMMRRRRRRRRR RRRRR	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	MIMSIMMMSIMMMIMIMMRIM MI	MMMMMRHIIRMRMMMMMMRIRRMRMM I	MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	1 2 3 4 4 5 6 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 22 22 24 22 5 22 9 30 31 32 33 33

<sup>&</sup>quot; Union Carbide name.

# MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued) Table C

Compound number	Compounds	Acetone	+	n-Amyl cyanide	Anisaldehyde	Benzene	Benzyl ether	Chloroform	o-Cresol	Diisobutyl ketone	_	_	Di-n-propyl aniline	Ethyl alcohol	Ethyl ether	3-Heptanol	n-Heptyl acetate	n-Hexyl ether	α-Methylbenzylamıne	a-Methylbenzyldiethanolamine		α-Methylbenzylethanolamine	2-Methyl-5-ethylpyridine		4-Methyl-n-valeric acid	o-Phenetidine	2-Phenylethylamine	Isopropanolamine	Pyridine	Salicylaldehyde	Tetradecanol	Tri-n-butyl phosphate	Triethylenetetramine	2,6,8-Tumethyl 4-nonanone
1 2 3 4	1,3-Butylene glycol 2,3-Butylene glycol 2-Chloroethanol 3-Chloro-1,2-pro-	M M M	M	M M M	M	I S M	I	M	M M M	M	M	M M M	I	M M M	S M M	M M M	M	I I M	М	M M M	M	M M M	M	M	M	M	M	М	M	M M M	M	M M M	M	Ī
-	panediol -	M	M	М	М	I	М	M	M	M	M	M	I	M	M	M	М	I	R	М	M	M	M	М	M	M	R	R	M	М	S	М	R	s
Э	Dibutyl hydrogen phosphite	М	M	M	M	M	M	M	M	M	M	M	М	M	M	М	M	M	М	М	М	М	М	М	М	M	М	М	M	М	М	М	М	М
6	ether	М	M	M	M	M	М	M	М	M	М	м	М	M	M	м	М	M	R	м	s	М	М	м	М	М	R	R	м	М	М	М	R	М
7	Diethylene glycol diethyl ether	M	M	M	м	М	м	м	M	м	M	М	М	M	м	м	М	М	$\mathbf{M}$	М	М	М	М	М	М	м	M	M	м	М	М	М	М	М
8			l	M						ĺ	ĺ			M	м	м	м	Nſ	м	м	M	м	м	м	м	м	M	м	м	м	м	м	м	М
9	Diethylene glycol							- 1						M	Ì	М						' <b> </b>										м	ļ.	
10	monoethyl ether Diethylene glycol		1	M				Į	- 1	Į	i		- 1		l							l	- 1		l				.	. 1		l	- 1	- 1
11	monomethyl ether Dipropylene glycol	M M	M	M M	M M	M M	M M	M M	M M	M M	M M	M	M M	M M	M	M M	М	T	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M
12		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	Ι	М	M	M	M	$\mathbf{M}$	M	M	M	$\mathbf{M}$	M	M	M	М	M	M	M
13	Ethylene glycol		1	Ι	Ι	Ι	I	$\mathbf{s}$	M	I	M	M	1	M	Ι	М	Ι	Ι	M	M	M	M	M	Ι	M	M	M	M	М	I	I	s	M	1
14	Ethyl glycol ethylbutyl ether	M	M	M	M	M	M	M	M	M	м	M	м	M	м	М	м	М	м	м	М	м	M	м	м	м	м	м	м	М	м	М	М	M
15	Ethylene glycol							- 1	ı	- 1				M	λđ	\ \ \	M	M	١,٢	M	M		14	M	1	11	3.1	۱ſ	٦ſ	M	١ſ	м	11	M
16	monobutyl ether Ethylene glycol	M	M	M	М	М	M	M	M	M	M	IVI	M	M	IVI	IVI	.VI	M	.51	.51	NI	.VI	. 11	.,1	.11	.,1	-71	31	.11	-11	.51	.,1	.,1	. 1
•	monoethyl ether	М	M	M	M	M	M	M	M	M	M	M	M	M	М	М	М	M	М	М	М	M	M	M	M	M	M	М	М	М	М	M	М	M
17														16		3.6	34	3.6	\ A	3.4			24			M		24	<b>M</b>	2.6	λſ	$\mathbf{x}$	M	
18	monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	iVI	M	IV1	w	IVI	M	IVI	IVI	'AT	M	.VI	.V1	M	141	.VI	.V1	7/1	M	.V1	IVI
10	Ethylene glycol monophenyl ether	M	м	M	м	м	м	м	м	м	м	м	м	M	М	M	м	М	M	M	M	М	M	M	M	M	M	M	М	M	M	М	м	М
19		Ι	I	I	I	I )	I	I	M	I	1	Mί	1 ]			1	I	Ι	M	M	I	M	Μl	I	I	ΙÌ	M	M	M	ΙÌ	I	I	M	I
20	1,2-Propanediol	M	M	M	M	I	Ι	M	M	I	Μļ			M	$\mathbf{S}$	M		Ī	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	Ī
21	1,3-Propanediol	M				I	I	M	M	Ιļ	M	ΜĮ	ĪΙ	M	I S I I	M		Î	M	M	M	M	M	M	M	ΜĮ	M	M	M	Ļ	S	M	M	Ţ
22	Tricthylene glycol	M	I	M	M	$\mathbf{S}_{\parallel}$	IJ	M	M)	1	M	M		M	1	M	L	I	M	M	M	M	M	M	M	M	M	M	M	M	1	M	M	1
23		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	IVI	NI.	M	IVI	IVI	W	IVI	.VI	M	W	IVI
24		7.4	\ \ <b>x</b> #	7.	7.4	7.	, d	إير		, l	N/	ᇄ	l	M	м	7.4	м	34	ъ	11	74	14	<sub>D</sub>	$\mathbf{x}$	N.E	M	ъ I	ъ	M	M	1/1	7/1	R	M
1	chlorohydrin	IVI	IVI	IAT,	IVI [	IAT	1V1 (	TAL ,	TAI,	TAT ;	TATI	145	TAT (	YAT	1141	TAT	TAT	TAT.	IL.	TAT.	'AI'	71T,	Tr,	TAT ,	.111	TAT	10.	10	. VI	TAT ,	**1	AT.	10	1411

<sup>c</sup> Union Carbide name.

# EMERGENT STEM CORRECTION FOR LIQUID-IN-GLASS THERMOMETERS

Accurate thermometers are calibrated with the entire stem immersed in the bath which determines the temperature of the thermometer bulb. However, for reasons of convenience it is common practice when using a thermometer to permit its stem to extend out of the apparatus. Under these conditions both the stem and the mercury in the exposed stem are at a temperature different from that of the bulb. This introduces an error into the observed temperature. Since the coefficient of thermal expansion of glass is less than that of mercury, the observed temperature will be less than the true temperature if the bulb is hotter than the stem and greater than the true temperature, providing the thermal gradient is reversed. For exact work the magnitude of this error can only be determined by experiment. However, for most purposes it is sufficiently accurate to apply the following equation which takes into account the difference of the thermal expansion of glass and mercury:

$$T_c = T_o + F \times L(T_o - T_m)$$

Where

 $T_c$  = corrected temperature

 $T_o$  = observed temperature

T<sub>m</sub> = mean temperature of exposed stem. The mean temperature of the exposed stem may be determined by fastening the bulb of a second thermometer against the midpoint of the exposed liquid column.

L = the length of the exposed column in degrees above the surface of the substance whose temperature is being determined.

F = correction factor. For approximate work and when the liquid in the thermometer is mercury a value for F of 0.00016 is generally used. For more accurate work with mercury filled thermometers values as given in the following table are used. For thermometers filled with organic liquids it is customary to use 0.001 for the value of F

	Values of F for various glasses											
Tm°C.	Corning 0041	Corning 8800	Corning 8810	Jena 16 III	Jena 59 III							
50	0.000157	0.000166	0.000156	0.000158	0.000164							
150	0.000159	0.000167	0.000157	Ů.000158	0.000165							
250	0.000163	0.000168	0.000161	0.000161	0.000170							
350	0.000168	0.000173	0.000166		0.000177							

#### CORRECTION OF BOILING POINTS TO STANDARD PRESSURE

BY H. B. HASS AND R. F. NEWTON

This correction may be made by using the equation:

$$\Delta t = \frac{(273.1 + t)(2.8808 - \log p)}{\phi + .15(2.8808 - \log p)} \tag{1}$$

where  $\Delta t = \text{degrees } C \text{ to be added to the observed boiling point.}$ 

t = the observed boiling point.

 $\log p$  = the logarithm of the observed pressure in millimeters of mercury.

 $\phi$  = the entropy of vaporization at 760 mm.

The value of  $\phi$  may be estimated from the graph and the table. Substances not included in the table may be classified by grouping them with compounds which bear a close physical or structural resemblance to them.

Example 1. Benzene boils at 20°C. at 75 mm pressure. What is its normal boiling point? We do not find benzene in the table but we find hydrocarbons in group 2, and a group 2 compound with a boiling point of 20° has a  $\phi$  of 4.6.

Substituting in the equation

$$\Delta t = \frac{(273.1 + 20)(2.8808 - 1.8751)}{4.60 + .15(2.8808 - 1.8751)} = 62^{\circ}$$

Adding this to 20° gives 82° as a first approximation.

The graph shows that the  $\phi$  for a compound of group 2 boiling at 82° is 4.72 instead of 4.60 which we originally used. Since  $\phi$  is in the denominator, this increase will lower our  $\Delta t$  by the ratio, 4.60/4.72, or the corrected  $\Delta t$  is  $62 \times 4.60/4.72 = 60.4$ . Adding  $\Delta t$  to t, gives 80.4° as a second approximation.

The formula can best be used in a slightly different form when the reverse calculation is desired, i.e., when one calculates the vapor pressure at a given temperature, lower than the normal boiling point.

$$2.8808 - \log p = \frac{\phi \Delta t}{273.1 + t - .15 \Delta t} \tag{2}$$

Example 2. Alcohol boils at 78.4°C. What is its vapor pressure at 20°C.? Substituting in equation 2:

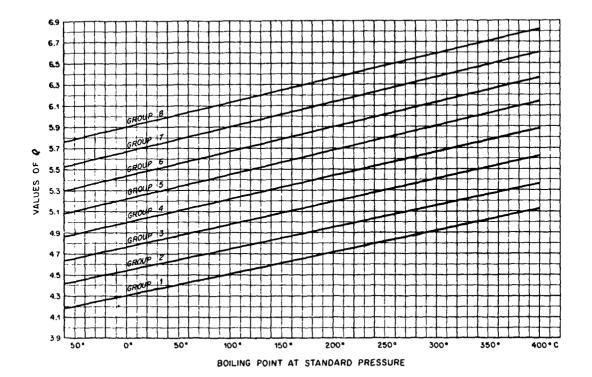
$$2.8808 - \log p = \frac{6.06 \times 58.4}{293.1 - (.15 \times 58.4)} = 1.245$$
$$\log p = 2.8808 - 1.245 = 1.6358$$
$$p = 43.2 \text{ mm}.$$

Here no second approximation is necessary, since the correct value of  $\phi$  was taken immediately, the normal boiling point having been known.

Compound	Group	Compound	Group
Acetaldehyde	3	Benzyl alcohol	5
Acetic acid	4	Butylethylene	1
Acetic anhydride	6	Butyric acid	7
Acetone	3	Camphor	2
Acetophenone	4	Carbon monoxide	l
Amines	3	Carbon oxysulfide	2
n-Amyl alcohol	8	Carbon suboxide	2
Anthracene	1	Carbon sulfoselenide	2
Anthraquinone	1	m.p. Chloroanilines	3
Benzaldehyde	2	Chlorinated derivatives	Same group as
Benzoic acid	5		though Cl was H
Benzonitrile	2	o.m.p. Cresols	4
Benzophenone	$\overline{\underline{2}}$	Cyanogen	4

# CORRECTION OF BOILING POINTS (Continued)

Compound	Group	Compound	Group
Cyanogen chloride	3	Methyl benzoate	3
Dibenzyl ketone	2	Methyl ether	3
Dimethyl amine	4	Methyl ethyl ether	3
Dimethyl oxalate	4	Methyl ethyl ketone	2
Dimethyl silicane	2	Methyl fluoride	3
Esters	3	Methyl formate	4
Ethanol	8	Methyl salicylate	2
Ethers	2	Methyl silicane	ļ
Ethylamine	4	$\alpha,\beta$ Naphthols	3
Ethylene glycol	7	Nitrobenzene	3
Ethylene oxide	3	Nitromethane	3
Formic acid	3	o.m.p. Nitrotoluenes	2
Glycol diacetate	4	o.m.p. Nitrotoluidines	2
Halogen derivatives	Same group as	Phenanthrene	1
_	though halogen	Phenol	5
	were hydrogen.	Phosgene	2
Heptylic acid	7	Phthalic anhydride	2
Hydrocarbons	2	Propionic acid	5
Hydrogen cyanide	3	n-Propyl alcohol	8
Isoamyl alcohol	7	Quinoline	2
Isobutyl alcohol	8	Sulfides	2
Isobutyric acid	6	Tetranitromethane	3
Isocaproic acid	7	Trichloroethylene	I
Methane	1	Valeric acid	7
Methanol	7	Water	6
Methyl amine	5		



### MOLECULAR ELEVATION OF THE BOILING POINT

(Most values from Hoyt, C.S. and Fink, C.K., Journal of Physical Chemistry, Vol. 41, No. 3., March, 1937.) Molecular elevation of the boiling point showing the elevation of the boiling point in degrees C due to the addition of one gram molecular weight of the dissolved substance to 1000 grams of any one of the solvents below. The correction in the last column gives the number of degrees to be subtracted for each mm. of difference between the barometric reading and 760 mm.

Solvent	Кв	Barometric Correction per mm.
Acetic acid	3.07	0.0008
Acetone	1.71	0.0004
Aniline	3.52	0.0009
Benzene	2.53	0.0007
Bromobenzene	6.26	0.0016
Carbon bisulfide	2.34	0.0006
Carbon tetrachloride	5.03	0.0013
Chloroform	3.63	0.0009
Cyclohexane ·	2.79	0.0007
Ethanol (ethyl alcohol)	1.22	0.0003
Ethyl acetate	2.77	0.0007
Ethyl ether	2.02	0.0005
n-Hexane	2.75	0.0007
Methanol (methyl alcohol)	0.83	0.0002
Methyl acetate	2.15	0.0005
Nitrobenzene	5.24	0.0013
n-Octane	4.02	0.0010
Phenol	3.56	0.0009
Toluene	3.33	0.0008
Water	0.512	0.0001

### MOLECULAR DEPRESSION OF THE FREEZING POINT

Showing the depression of the freezing point due to the addition of one gram molecular weight of solute, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C	Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C
Acetic acid	3.90	Diphenyamine	8.60
Acetophenone	5.65	Diphenyl ether	8.00
Aniline	5.87	Ethylene dibromide	11.80
Anthracene	14.65	Ethyl ether	11.79
Anthraquinone	14.80	Formic acid	2.77-2.80
Benzene	4.90-5.23	Hexachlorobenzene	20.75
Benzoic acid	7.85-8.79	Menthol	12.4
Benzophenone	9.88	Naphthalene	6.90-7.10
d-Bromocamphor	11.87	β-Naphthol	11.25
Bromoform	14.25	Nitrobenzene	6.89-7.10
tert-Butyl alcohol	12.80	Phenenthrene	12.0
Camphor .	49.80	Phenol	7.20-7.50
Carbazole	12.30	Phenylhydrazine	5.86
Carbon disulfide	3.83	Pyridine	4.97
Carbon tetrachloride	29.8-34.8	Stearic acid	4.50
Chloroform	4.67~4.90	Triphenylmethane	12.45
Cyclohexane	20.0-20.30	Urethane	5.00-5.14
Dicyclohexyl	14.50	Water	1.85-1.87
m-Dinitrobenzene	10.60	p-Xylene	4.30
Diphenyl	8.00-8.35		

#### **CARBOHYDRATES**

These data for carbohydrates were compiled originally for the Biology Data Book by M L Wolfram, G G Maher and R G Pagnucco (1964) Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D C pp 351-359

All data are for crystalline substances, unless otherwise specified Selection of substances was restricted to natural carbohydrates found free (or in chemical combination and released on hydrolysis) and to biological oxidation products of the natural carbohydrates. The nomenclature conforms with that of the British-American report as published in the *Journal of Organic Chemistry*, 28-281 (1963) Substances have been arranged alphabetically under the name of the parent sugar within groups formulated according to increasing carbon content (excluding carbon in substituents), with synonymous common names in parentheses. **Melting Point:** b p = boiling point, d = decomposes, s = sinters. **Specific Rotation** was determined in water at concentrations of 1-5 g per 100 ml of solution and at  $20^{\circ}-25^{\circ}$ C, unless otherwise specified, other temperatures or wavelengths are shown in brackets. c = grams solute per 100 ml of solution.

Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
	(A)	(B)	(C)	(D)
		Aldose	s	
1	D-Glyceraldehyde	C <sub>3</sub> H <sub>6</sub> O <sub>3</sub>		$+13.5 \pm 0.5 \text{ (syrup)}$
2	p-Glyceraldehyde, 3-deoxy-3,3-C-bis- (hydroxymethyl)- (Cordycepose)	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>		-26 (c 0 6, C <sub>2</sub> H <sub>5</sub> OH
3	p-Glyceraldehyde, 3,3-bis(C-hydroxy- methyl)- (Apiose)	C5H10O5		+5 6 (c 10) [15°] syrup
4	β-D-Arabinose	$C_5H_{10}O_5$	155	$-175 \rightarrow -103$
5	D-Arabinose, 2-O-methyl-	$C_6H_{12}O_5$	Syrup	-102
6	$\alpha$ -L-Arabinose	C5H10O5	158 amorphous	$+554 \rightarrow +105$
7	β-L-Arabinose	C5H19O5	160	$+190.6 \rightarrow +104.5$
8	DL-Arabinose	C5H10O5	163 5-164 5	None
9	α-L-Lyxose	C5H10O5	105	$+5.8 \rightarrow +13.5$
10	L-Lyxose, 5-deoxy-3-C-formyl- (Streptose)	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		
11	L-Lyxose, 3-C-formyl- (Hydroxy- streptose)	C6H10O6		
12	Pentose, 4,5-anhydro-5-deoxy-D- erythro-	C <sub>5</sub> H <sub>8</sub> O <sub>3</sub>		
13	Pentose, 2-deoxy-D-erythro-	C5H10O4	96-98	$-91 \rightarrow -58$
	p-Ribose	$C_5H_{10}O_5$	87	$-23.1 \rightarrow -23.7$
15	D-Ribose, 2-C-hydroxymethyl- (Hamamelose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		-7 1 [λ578]
16	α-D-Xylose	C5H10O5	145	$+93.6 \rightarrow +18.8$
17	D-Xylose, 5-deoxy-	C5H10O4	1	+16
	β-D-Xylose, 2-O-methyl-	$C_6H_{12}O_5$	137-138	$-21 \rightarrow +34$
	α-D-Xylose, 3-O-methyl-	C6H12O5	95	$+45 \rightarrow +19$
	D-Allose, 6-deoxy-	C6H12O5	140-143	$+16[18^{\circ}](c\ 0\ 6)$
	·		146-148	$-4.7 \rightarrow 0$
21	D-Allose, 6-deoxy-2,3-di-O-methyl- (Mycinose)	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	102-106	$-46 \rightarrow -29$
22	Amicetose (a trideoxy hexose)	C <sub>6</sub> H <sub>12</sub> O <sub>3</sub>	Oil, bp 65-70	+28 6 (CHCl <sub>3</sub> )
23	·	C6H12O5	1 -	Levo
24	α-D-Galactose	C6H12O6	167	$+150.7 \rightarrow +80.2$
25	β-D-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	143-145	$+52.8 \rightarrow +80.2$
26	D-Galactose, 3,6-anhydro-	C6H10O5		+21 3 [10°]
	α-D-Galactose, 6-deoxy- (D-Fucose, Rhodeose)	C <sub>6</sub> H <sub>12</sub> O <sub>9</sub>	140-145	$+127 \rightarrow +76 \ 3 \ (c \ 10)$
28	D-Galactose, 6-deoxy-3-0-methyl- (Digitalose)	C7H14O5	1061, 1192	+106

# CARBOHYDRATES (Continued) Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_{\mathcal{D}}$
	(A)	(B)	(C)	(D)
		Aldoses (C	on t)	
29	p-Galactose, 6-deoxy-4-0-methyl-	C7H14O5	131–132	+82
30	p-Galactose, 6-deoxy-2,3-di-O-methyl-	$C_8H_{16}O_5$		+73
31	α-D-Galactose, 3-O-methyl-	C7H14O6	144-147	$+1506 \rightarrow +1086$
32	α-D-Galactose, 6-O-methyl-	C7H14O6	122-123	$+117 \rightarrow +773$
33	L-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		See D-Galactose
34	α-L-Galactose, 3,6-anhydro-	C6H10O5		$-39.4 \rightarrow -25.2$
35	α-L-Galactose, 6-deoxy- (L-Fucose)	C6H12O5	145	$-124 \ 1 \rightarrow -76 \ 4$
6	L-Galactose, 6-deoxy-2-O-methyl-	C7H14O5	149-150	$-75 \pm 4 \ (c \ 0 \ 5)$
37	L-Galactose, 6-sulfate	$C_6H_{12}O_9S$		-47 (c 0 2) (Na sal
8	DL-Galactose	C6H12O6	143-144, 163	None (racemic)
39	α-D-Glucose	C6H12O6	146, 83 (H <sub>2</sub> O)	$+112 \rightarrow +527$
Ю	β-D-Glucose	C6H12O6	148-150	$+187 \rightarrow +527$
1	p-Glucose, 6-acetate	C7H14O7	135	+48
	p-Glucose, 2,3-di-O-methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	85-86, 121	+50
	p-Glucose, 6-O-benzoyl- (Vaccinin)	C13H16O7	Amorphous	+48 (C <sub>2</sub> H <sub>5</sub> OH)
	α-D-Glucose, 6-deoxy- (Chinovose, Epirhamnose, Glucomethylose, Isorhamnose, Isorhodeose Quino- vose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	139–140	$+733 \rightarrow +297$ (c
15	α-p-Glucose, 6-deoxy-3-O-methyl- (p-Thevetose)	C7H14O5	116	+84 → +33
16	p-Glucose, 6-sulfonic acid, 6-deoxy- (6-Sulfoquinovose)	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub> S	173-174	+873
17	p-Glucose, 3-O-methyl-	C7H14O6	162-167	$+98 \rightarrow +595$
8	α-L-Glucose	C6H12O6	141-143	$-95.5 \rightarrow -51.4$
	L-Glucose, 6-deoxy-3-O-methyl- (L-Thevetose)	C7H14O5	126–129	$-369 \pm 2$
	p-Gulose, 6-deoxy-	$C_6H_{12}O_5$		
	Hexose, 2-deoxy-D-arabino-4	$C_6H_{12}O_5$	148	+46 6 [18°]
l	Hexose, 2,6-dideoxy-3-O-methyl-D- arabino- (D-Oleandrose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>		-11
	Hexose, 3,6-dideoxy-D-arabino- (Tyvelose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+24 ± 2
1	Hexose, 2,6-dideoxy-3-O-methyl-L- arabino- (L-Oleandrose)	C7H14O4	62-63	+11 9 ± 2 5
	Hexose, 3,6-dideoxy-L-arabino- (Ascarylose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	00.00	$-24 \pm 2$
	Hexose, 2,6-dideoxy-3-O-methyl-p- lyxo- (Diginose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	90-92	$+56 \pm 4$ $-61 6$
	Hexose, 2,6-dideoxy-1-lyxo- (1-Fucose, 2-deoxy-)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub> C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	78-85	-65
-	Hexose, 2,6-dideoxy-3-0-methyl-L-			
1	Hexose, 2,6-dideoxy-D-ribo- (Digitoxose, p-Altrose, 2,6-dideoxy-)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	93	+46 4 +52
- {	Hexose, 2,6-dideoxy-3-0-methyl-p-ribo- (Cymarose)	C <sub>2</sub> H <sub>14</sub> O <sub>4</sub>	00	$\begin{vmatrix} +32 \\ +10 \pm 2 & (c \ 0 \ 9) \end{vmatrix}$
	Hexose, 3,6-dideoxy-p-ribo- (Paratose) Hexose, 4,6-dideoxy-3-O-methyl-p- ribo- (p-Gulose, 4,6-dideoxy-3-O- methyl-, Chalcose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub> C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	96–99	$\begin{array}{c} +10 \pm 2 \ (609) \\ +120 \rightarrow +76 \end{array}$
3	Hexose, 2,6-dideoxy-D-xylo- (Boivinose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	96–98	$-39 \rightarrow +39$

# CARBOHYDRATES (Continued) Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
	(A)	(B)	(C)	(D)
		Aldoses (C	on't)	
64	Hexose, 2,6-dideoxy-3-O-methyl-D- xylo- (Sarmentose)	C7H14O4	78–79	$+12 \rightarrow +15 8$
65	Hexose, 3,6-dideoxy-D-xylo- (Abequose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		$-32 \pm 06$
١	Hexose, 2,6-dideoxy-3-C-methyl-L-xylo- (Mycarose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	129-129	-31 1
	Hexose, 2,6-dideoxy-3-C-methyl-3-O-methyl-1-c-xylo-(Cladinose)	C <sub>8</sub> H <sub>16</sub> O <sub>4</sub>	oil, b p 120-132 (0 25 mm)	-23 1
	Hexose, 3,6-dideoxy-L-xylo- (Colitose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		$+4 (H2O), -51 \pm 2$ (CH <sub>3</sub> OH)
	D-Idose <sup>5</sup>	$C_6H_{12}O_6$	İ	
	L-Idose, 1,6-anhydro-	$C_6H_{10}O_5$		
71	α-D-Mannose	$C_6H_{12}O_6$	133	$+29.3 \rightarrow +14.5$
72	β-D-Mannose	$C_6H_{12}O_6$	132	$-163 \rightarrow +145$
73	D-Mannose, 6-deoxy- (D-Rhamnose)	C6H12O5	86-90	-70
١	α-L-Mannose, 6-deoxy-monohydrate (L-Rhamnose)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	93-94	$-8 \ 6 \rightarrow +8 \ 2$
	β-L-Mannose, 6-deoxy-	$C_6H_{12}O_5$	123-125	$+38.4 \rightarrow +8.9$
76	L-Mannose, 6-deoxy-2-O-methyl-	C7H14O5		
77	L-Mannose, 6-deoxy-3-O-methyl- (L-Acofriose)	C7H14O5	114–115	+30 [18°]
78	L-Mannose, 6-deoxy-2,4-di-O-methyl-	C8H16O5	82	-19 [16°]
79	L-Mannose, 6-deoxy-5-C-methyl-4-O-methyl-(Noviose)	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	128-130	+19 9 (50% C <sub>2</sub> H <sub>5</sub> OF
80	Rhodinose (a 2,3,6-trideoxyhexose)	$C_6H_{12}O_3$		$-11 \pm 16$
	p-Talose	$C_6H_{12}O_6$	128-132	+16 9
82	D-Talose, 6-deoxy- (D-Talomethylose)	$C_6H_{12}O_5$	129-131	+20 6
	L-Talose, 6-deoxy- (L-Talomethylose)	$C_6H_{12}O_5$	116-118	$-195 \pm 2  [18^{\circ}]$
	L-Talose, 6-deoxy-2-O-methyl- (L- Acovenose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>		-19 4
85	Heptose, D-glycero-D-galacto-	C7H14O7	139-140	$+47 \rightarrow +64 \ (c\ 0\ 5)$
	Heptose, D-glycero-D-manno-	$C_7H_{14}O_7$		,
	Heptose, D-glycero-L-manno-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
		Ketoses	3	
	Dihydroxyacetone	C3H6O3	80 (dimer)	None
- 1	Tetrulose, L-glycero-8 (L-Erythrulose, Ketoerythritol, L-Threulose)	C <sub>4</sub> H <sub>8</sub> O <sub>4</sub>	Syrup	+12
- [	Pentulose, p-erythro- (Adonose, p-Ribulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	Syrup	+16 6 [27°]
116	Pentulose, L-erythro- (L-Ribulose)	C5H10O5		-166
	Pentulose, p-threo- (p-Xylulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	1	-33
	Pentulose, 5-deoxy-D-threo-	$C_5H_{10}O_4$	!	$-5 \pm 1 \text{ (CH}_3\text{OH)}$
- 1	Pentulose, L-threo- (L-Xylulose, L- Lyxulose, Xyloketose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	Syrup	+33 1
Ì	Hexulose, $\beta$ -D-arabino- $(\beta$ -D-Fructose, Levulose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	102-1047	$\begin{vmatrix} -133 \ 5 \rightarrow \ -92 \end{vmatrix}$
	Hexulose, 6-deoxy-D-arabino- (D-Rhamnulose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		$-13 \pm 2$
7	Hexulose, D-lyxo- (D-Tagatose)	C6H12O6	131-132	$+27 \rightarrow -4, -5$
98	5-Hexulose, D-lyxo	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	158	-86 6
	Hexulose, 6-deoxy-L-lyxo- (L-Fuculose)	C6H12O5		F

CARBOHYDRATES (Continued) Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [a]D
	(A)	(B)	(C)	(D)
		Ketoses (C	Con't)	
100	Hexulose, p-ribo- (p-Psicose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	Amorphous	+47
101	Hexulose, L-xylo- (L-Sorbose)	C6H12O6	159-161	-43 1
102	Hexulose, 6-deoxy-L-xylo-	C6H12O5	88	$-25 \pm 2 \ (c \ 0 \ 7)$
	Heptulose, p-altro- (Sedoheptulose, Sedoheptose)	C7H14O7	Amorphous	+2 5 (c 10)
104	Heptulose hemihydrate, L-galacto- (Perseulose)	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub> .	110–115	-90 → -80
105	Heptulose, L-gulo-	C7H14O7		-28
106	Heptulose, D-1do-	C7H14O7	172	$-34 \pm 8 \ (c \ 0.3)$
107	Heptulose, p-manno- (Mannoketo- heptose, p-Mannotagatoheptose)	C7H14O7	152	+29.4
108	Heptulose, D-talo-	C7H14O7		
109	Octulose, D-glycero-L-galacto-	C8H16O8		$-57, -43.4 \rightarrow -13.4$
110	Octulose, D-glycero-D-manno-	C <sub>8</sub> H <sub>16</sub> O <sub>8</sub>		+20 (CH <sub>3</sub> OH)

<sup>&</sup>lt;sup>1</sup> Original melting point. <sup>2</sup> Melting point after four-months' storage <sup>3</sup> As a methyl glycoside cyclohexylamine salt. 4 Included because of speculations concerning it in biological processes. 5 Either D-idose or L-altrose is in the polysaccharide varianose. 6 Early literature refers to this as D-erythrose. 7 The  $\cdot \frac{1}{2} H_2 O$ and .2H2O forms also exist.

Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>		
	(A)	(B)	(C)	(D)		
		Aldosam	ines			
1	p-Ribose, 3-amino-3-deoxy-	C <sub>5</sub> H <sub>11</sub> NO <sub>4</sub>	158-158.5 d.	-24 6 (hydrochloride)		
2	p-Galactose, 2-amino-2-deoxy- (Galactosamine; Chondrosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	185	$+121 \rightarrow +80$ (hydrochloride)		
3	α-L-Galactose, 2-amino-2,6-dideoxy- (L-Fucosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	192–193 d.	$-119 \rightarrow -92 [27^{\circ}]$ (hydrochloride)		
4	α-D-Glucose, 2-amino-2-deoxy- (Glu- cosamine; Chitosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	88	$+100 \rightarrow +47.5$		
5	β-D-Glucose, 2-amino-2-deoxy-	C6H18NO5	110-111	$+28 \to +47.5$		
6	p-Glucose, 3-amino-3-deoxy- (Kanos-amine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	128 d.	+19 [14°]		
7	p-Glucose, 6-amino-6-deoxy-	C <sub>6</sub> H <sub>18</sub> NO <sub>5</sub>	161–162 d.	$+23 \rightarrow +50.1$ (hydrochloride)		
8	D-Glucose, 2,6-diamino-2,6-dideoxy- (Neosamine C)	C <sub>6</sub> H <sub>14</sub> N <sub>2</sub> O <sub>4</sub>	>230	+61.5 (dihydrochlo-		
9	· ·	C <sub>8</sub> H <sub>17</sub> NO <sub>4</sub>	115–116	+31 (hydrochloride)		
10	D-Glucose, 4,6-dideoxy-4-dimethyl-	C <sub>8</sub> H <sub>17</sub> NO <sub>4</sub>	192–193	+45.5 (hydrochloride)		
11	L-Glucose, 2-deoxy-2-methylamino-	C7H15NO5	130-132	-64		
	D-Gulose, 2-amino-1,6-anhydro-2- deoxy-	C <sub>6</sub> H <sub>11</sub> NO <sub>4</sub>	250-260 d.	+41 ± 2 (hydrochloride)		
13	p-Gulose, 2-amino-2-deoxy-	C <sub>6</sub> H NO <sub>5</sub>	152-162 d.	$+5.6 \rightarrow -18.7$ (hydrochloride)		

CARBOHYDRATES (Continued)
Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS (Continued)

	Substance (Synonym)	Chemical Melting Point °C		Specific Rotation $[\alpha]_{D}$	
	(A)	(B)	(C)	(D)	
		Aldosamines	(Con't)	·	
14	Hexose, 3,4,6-trideoxy-3-dimethyl- amino-D-xylo- (Desosamine, Picro- cine)	C <sub>8</sub> H <sub>17</sub> NO <sub>3</sub>	189–191 d	+49 5 (c 10) (hydro- chloride)	
15	Hexose, a 4-acetamido-2-amino-2,4,6-trideoxy-	C <sub>8</sub> H <sub>16</sub> N <sub>2</sub> O <sub>4</sub>	216–219	$+115 \rightarrow +94 [26^{\circ}]$ (c 0 05)	
16	Hexose, an amino-deoxy-3-0-carboxy- ethyl-	C <sub>9</sub> H <sub>17</sub> NO <sub>7</sub>			
	Hexose, a 2,6-diamino-2,6-dideoxy- (Neosamine B, Paramose)	C <sub>6</sub> H <sub>14</sub> N <sub>2</sub> O <sub>4</sub>	135–150 d	+17 5 (c 0 9 (hydro- chloride)	
	Hexose, a 3-dimethylamino-2,3,6-trideoxy- (Rhodosamine)	C <sub>8</sub> H <sub>17</sub> NO <sub>3</sub>			
	D-Mannose, 2-amino-2-deoxy- (Mannosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	142 d	-43 (c 9) (hydro- chloride)	
20	D-Mannose, 3-amino-3,6-dideoxy- (Mycosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	162	-11 5 (hydrochloride)	
21	D-Talose, 2-amino-2-deoxy- (Talos-amine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	151–153	$+3.4 \rightarrow -5.7 (c.0.9)$ (hydrochloride)	
22	L-Talose, 2-amino-2,6-dideoxy- (Pneumosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	162–163	$+6.9 \rightarrow +10.4$ (hydrochloride)	
		Ketosamı	nes	`	
23	Pentulose, 1-(o-carboxyanılıno)-1- deoxy-p-erythro-	C12H14NO6			
24	Hexulose, 1-(o-carboxyanılıno)-1- deoxy-p-arabino-	C13H16NO7			
	Hexulose, 5-amino-5-deoxy-L-xylo- Hexulose, 6-deoxy-6-(N-methyl- acetamido)-L-xylo-	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub> C <sub>9</sub> H <sub>17</sub> NO <sub>6</sub>	174–176	-62	
]	Part III. NATURAL ALDITOLS A	ND INOSIT	OLS (with Inososes	s and Inosamines)	
	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>	

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>		
	(A)	(B)	(C)	(D)		
		Alditols	8			
1	Glycerol	C <sub>8</sub> H <sub>8</sub> O <sub>3</sub>	20	None		
2	Glycerol, 1-deoxy- (1,2-Propane-diol)1	C <sub>3</sub> H <sub>8</sub> O <sub>2</sub>	Oil, b p 188-189	None (racemic)		
3	Erythritol	C4H10O4	118-120	None (meso)		
4	Erythritol, 1,4-dideoxy- (2,3-Butylene-glycol)	C4H10O2	25, 34	None (meso)		
5	p-Threitol, 1,4-dideoxy-	C4H10O2	19	-130		
6	L-Threitol, 1,4-dideoxy-	C4H10O2		+10 2		
7	DL-Threitol, 1,4-dideoxy-	C4H10O2	7 6	None (racemic)		
8	D-Arabinitol	C <sub>5</sub> H <sub>12</sub> O <sub>5</sub>	103	+7.82 (c. 8, borax solution)		
9	L-Arabinitol	C5H12O5	101–102	-32 (c 0 4, 5% molybdate)		
10	Ribitol (Adomitol)	$C_{\delta}H_{12}O_{\delta}$	102	None (meso)		
11	Galactitol (Dulcitol)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	186–188	None (meso)		

# CARBOHYDRATES (Continued) Part III. NATURAL ALDITOLS AND INOSITOLS (with Inososes and Inosamines) (Continued)

,	1	ines) (Continued)	
Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
	Alditols (C	Con't)	
p-Glucital (Sorbital)	C.H.O.	112	-1.8 [15°]
		140-141	+42.4
L-Iditol		73.5	$-3\ 5\ (c\ 10)$
D-Mannitol	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	166	-0.21
D-Mannitol, 1,5-anhydro- (Styracitol)	C6H12O5	157	-49.9
Heptitol, p-glycero-p-galacto- (Heptitol, L-glycero-p-manno-; Perseitol)	C7H16O7	183–185, 188	-1.1
Heptitol, <b>D</b> -glycero- <b>D</b> -gluco- (Heptitol, <b>L</b> -glycero- <b>D</b> -talo-; β-Sedoheptitol)	C7H16O7	131–132	+46 (5% NH <sub>4</sub> molybedate)
Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-talo-; Volemitol)	C7H16O7	153	+2.65
Octitol, D-erythro-D-galacto-	$C_8H_{18}O_8$ . $H_2O$	169–170	-11 (5% NH <sub>4</sub> molybdate)
	Inosito	s	
Betitol (a dideoxy inositol)	C.H.O.	224	1
Bioinosose (scyllo-Inosose; myo-	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	198–200	None (meso)
h-Bornesitol (a myo-inositol mono-	C7H14O3	200	+31.6
l-Bornesitol (a myo-inositol mono-	C7H14O6	205–206	-32.1
Conduritol (a 2,3-dehydro-2,3-di-	C <sub>6</sub> H <sub>10</sub> O <sub>4</sub>	142-143	None (meso)
Cordycepic acid (a tetrahydroxycyclo- hexanecarboxylic acid) <sup>2</sup>	C7H12O6		
Dambonitol (a myo-inositol dimethyl ether)	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	206	None (meso)
DL-Inositol	C6H12O6	253	None (racemic)
d-Inositol	$C_6H_{12}O_6$		+60
<i>l</i> -Inositol	$C_6H_{12}O_6$	240	-65
	C7H14O6	266-269	-3
ether)			-25
		322-325	N (
myo-Inositol (meso-Inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		None (meso)
		į	+19.6
neo-Inosamine-2 (a deoxy amino	C <sub>5</sub> H <sub>14</sub> O <sub>6</sub> C <sub>6</sub> H <sub>13</sub> O <sub>5</sub> N	239–241 d.	None (meso)
d-Ononitol (a myo-inositol mono-	C7H14O6	172	+6.6
h-Pinitol (a dextro-inositol monomethyl	C7H14O6	186	+65.5
l-Pinitol (a levo-inositol monomethyl	C7H14O8	186	-65
l-Quebrachitol (a levo-inositol mono-	C7H14O6	190–191	-80.2 [28°]
	C6H12Os	235	+24.2
d-Quinic acid (a trideoxy carboxy	C <sub>7</sub> H <sub>12</sub> O <sub>6</sub>	164	+44 (c 10)
	D-Glucitol (Sorbitol) D-Glucitol, 1,5-anhydro- (Polygalitol) L-Iditol D-Mannitol, 1,5-anhydro- (Styracitol) Heptitol, D-glycero-D-galacto- (Heptitol, L-glycero-D-manno-; Perseitol) Heptitol, D-glycero-D-gluco- (Heptitol, L-glycero-D-talo-; B-Sedoheptitol) Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-talo-; Volemitol) Octitol, D-erythro-D-galacto-  Betitol (a dideoxy inositol) Bioinosose (scyllo-Inosose; myo- Inosose-2, a deoxy keto inositol) h-Bornesitol (a myo-inositol mono- methyl ether) l-Bornesitol (a myo-inositol mono- methyl ether) Conduritol (a 2,3-dehydro-2,3-di- deoxyinositol) Cordycepic acid (a tetrahydroxycyclo- hexanecarboxylic acid) <sup>2</sup> Dambonitol (a myo-inositol dimethyl ether) D1-Inositol d-Inositol l-Inositol l-Inositol Laminitol (a C-methyl myo-inositol) Liriodendritol (a myo-inositol dimethyl ether) muco-Inositol monomethyl ether myo-Inosose-1 (a deoxy keto inositol) Mytilitol (a C-methyl scyllo-inositol) neo-Inosamine-2 (a deoxy amino inositol) d-Ononitol (a myo-inositol mono- methyl ether) h-Pinitol (a levo-inositol monomethyl ether) l-Pinitol (a levo-inositol monomethyl ether)	Substance (Synonym)  (A)  (B)  Alditols (C  D-Glucitol (Sorbitol) D-Glucitol, 1,5-anhydro- (Polygalitol) L-Iditol D-Mannitol D-Mannitol D-Mannitol, 1,5-anhydro- (Styracitol) Heptitol, p-glycero-D-galacto- (Heptitol, L-glycero-D-manno-; Perseitol) Heptitol, p-glycero-D-gluco- (Heptitol, L-glycero-D-talo-; β-Sedoheptitol) Heptitol, p-glycero-D-manno- (Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-galacto-  Inositol  Betitol (a dideoxy inositol) Bioinosose (scyllo-Inosose; myo- Inosose-2, a deoxy keto inositol) h-Bornesitol (a myo-inositol mono- methyl ether) l-Bornesitol (a myo-inositol mono- methyl ether) Conduritol (a 2,3-dehydro-2,3-di- deoxyinositol) Cordycepic acid (a tetrahydroxycyclo- hexanecarboxylic acid) <sup>2</sup> Dambonitol (a myo-inositol dimethyl ether) D1-Inositol d-Inositol l-Inositol l-Inositol l-Inositol l-Inositol l-Inositol l-Inositol (a myo-inositol dimethyl ether) muco-Inositol monomethyl ether myo-Inositol (meso-Inositol) d-myo-Inosose-1 (a deoxy keto inositol) Mytilitol (a C-methyl scyllo-inositol) neo-Inosamine-2 (a deoxy keto inositol) meo-Inosamine-2 (a deoxy amino inositol) d-Ononitol (a myo-inositol monomethyl ether) h-Pinitol (a dextro-inositol monomethyl ether) h-Pinitol (a dextro-inositol monomethyl ether) l-Pinitol (a dextro-inositol monomethyl ether) l-Pinitol (a levo-inositol monomethyl ether) l-Pinitol (a levo-inositol monomethyl ether) l-Pinitol (a levo-inositol monomethyl ether) l-Pinitol (a levo-inositol monomethyl ether)	Carried   Carr

# CARBOHYDRATES (Continued) Part III. NATURAL ALDITOLS AND INOSITOLS (with Inososes and Inosamines) (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_{D}$
	(A)	(B)	(C)	(D)
		Inositols (C	on't)	
44	l-Quinic acid (a trideoxý carboxy levo- inositol)	C7H12O6	162	-42.1
45	Quinic acid, 5-dehydro-	C7H10O6	140~142 (138 s.)	-82.4 [28°]
46	Scyllitol (scyllo-Inositol; Cocositol)	C6H12O6	352-353	None (meso)
47	Sequoyitol (a <i>myo</i> -inositol monomethyl ether)	C7H14O6	234–235	None (meso)
48	Shikimic acid (a 3,4-anhydro-quinic acid)	C7H10O5	183–184	-200 [16°]
49	Shikimic acid, 5-dehydro-	C7H8O5	150-152	-57.5 [28°] (EtOH)
	Streptamine (2,4-diaminodideoxy-scyllitol)	C <sub>6</sub> H <sub>14</sub> O <sub>4</sub> N <sub>2</sub>	88, 210–250 d.	None (meso)
51	Streptamine, 2-deoxy-	C6H14O3N2		None (meso)
52	Streptadine (1,3-Dideoxy-1,3-diguani- dino-scyllitol)	C <sub>8</sub> H <sub>18</sub> N <sub>6</sub> O <sub>4</sub>		None (meso)
53	Viburnitol (a deoxy levo-inositol) <sup>3</sup>	$C_6H_{12}O_5$	174	-73.9

<sup>&</sup>lt;sup>1</sup> The 1-phosphate ester of this diol is said to occur in brain tissue and sea-urchin eggs. <sup>2</sup> Strong evidence that cordycepic acid is really p-mannitol. <sup>3</sup> Not an enantiomorph of d-quercitol; other isomeric relationship is involved.

Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_{\mathbf{D}}$
	(A)	(B)	(C)	(D)
		Aldonic A	cids	
1	p-Glyceric acid	C <sub>3</sub> H <sub>6</sub> O <sub>4</sub>	Gum	Dextro
2	L-Glyceric acid	C <sub>3</sub> H <sub>6</sub> O <sub>4</sub>	Gum	Levo
3	p-Arabinonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	114-116	+10.5 (c 6)
-	L-Arabinonic acid	$C_5H_{10}O_6$	118-119	$-9.6 \rightarrow -41.7^{1}$
	L-Arabinonic-1,4-lactone	C <sub>5</sub> H <sub>8</sub> O <sub>5</sub>	97-99	-72
6	p-Ribonic acid	$C_5H_{10}O_6$	112-113	-17.0
7	p-Xylonic acid	C5H10O6		$-2.9 \rightarrow +20.1^{1}$
8	L-Xylonic acid	C5H10O6		-91.8 <sup>1</sup>
9	p-Altronic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>		$+11.5 \rightarrow +24.8^{\circ}$ (Ca salt, N HCl)
10	p-Galactonic acid	C6H12O7	122	$-11.2 \rightarrow +57.6^{1}$
11	p-Gluconic acid	C6H12O7	130-132 (110-112 s.)	$-6.7 \rightarrow +11.9^{1}$
12	L-Gulonic acid	C6H12O7	Exists only in soln.	[ca. 0°]
13	Hexsonic acid, 2-deoxy-D-arabino-	C6H12O6	93-95	+68 (lactone)
	2-Hexulosonic acid, D-arabino-	C6H10O7		-81.7 (Na salt)
	2-Hexulosonic acid, 3-deoxy-D-erythro-	C6H10O6		-29.2 (c 6, Ca salt)
	2-Hexulosonic acid, D-lyxo-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	169	-5
	5-Hexulosonic acid, p-arabino-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	108-109	
	5-Hexulosonic acid, p-xylo-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	100 100	-14.5
	p-Mannonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>		-15.6
- 1	p-Gluconic acid, $O-\beta$ -p-galactopyranosyl- $(1 \rightarrow 4)$ - (Lactobionic acid)	C <sub>12</sub> H <sub>22</sub> O <sub>12</sub>		+25.1 (Ca salt)

# CARBOHYDRATES (Continued) Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α]p		
	(A)	(B)	(C)	(D)		
		Uronic A	eids			
21	L-Lyxuronic acid	C <sub>5</sub> H <sub>8</sub> O <sub>6</sub>				
22	β-p-Galacturonic acid	C6H10O7	160	$+27 \rightarrow +556$		
23	α-p-Galacturonic acid·monohydrate	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	159-160 (110-115 s )	$+97.9 \rightarrow +50.9$		
24	p-Galacturonic acid, 2-amino-2-deoxy-	C6H11O6N	160 d.	+84 5 (pH 2 HCl)		
25	β-D-Glucuronic acid	C6H10O7	156	$+117 \rightarrow +36.3$		
26	p-Glucuronic acid, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> O <sub>6</sub> N	120–172 d.	+55		
27	D-Glucuronic acid, 3-O-methyl-	C7H12O7	Syrup	+6		
28	L-Guluronic acid	C6H10O7				
29	L-Iduronic acid	C6H10O7		+30		
30	β-D-Mannuronic acid	C6H10O7	165–167	$-47.9 \rightarrow -23.9$		
31	$\alpha$ -D-Mannuronic acid·monohydrate	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	110 s , 120–130 d.	$+16 \rightarrow -61 \ (c \ 6.8)$		
		Aldarıc A	eids			
32	D-Tartaric acid	C <sub>4</sub> H <sub>6</sub> O <sub>6</sub>	170	-15		
33	L-Tartaric acid	C4H6O6	170	+15 [15°]		
34	L-Malic acid	$C_4H_6O_5$	100	-23 (c 8.4)		

<sup>&</sup>lt;sup>1</sup> Equilibrates with the lactone.

### FATS AND OILS

These data for fats and oils were compiled originally for the Biology Data Book by H. J. Harwood, and R. P. Geyer. 1964. Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D. C. pp. 380-382. Values are typical rather than average, and frequently were derived from specific analyses for particular samples (especially the constituent fatty acids). Extreme variations may occur, depending on a number

				C	onstants		
	Fat or Oil	Source	Melting (or Solidi- fication) Point, °C	Specific Gravity (or Density)	Refractive Index  n  D	Iodine Value	Saponi- fication Value
-	(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	Land Animals Butterfat	Bos taurus	32 2	0 91140°/15°	1 4548	36 1	227
2 3 4 5 6	Depot fat Lard oil Neat's-foot oil Tallow, beef Tallow, mutton	Homo sapiens Sus scroja B. taurus B. taurus Ovis aries	(15) (30 5) (42 0)	0 918 <sup>1</sup> ° 0 919 <sup>15°</sup> 0 910 <sup>25°</sup> 0 945 <sup>1</sup> °	1 4602 1 4615 1 464 <sup>25°</sup> 1 4565	67 6 58 6 69-76 49 5 40	196 2 194 6 190-199 197 194
7 8 9	Marine Animals Cod-liver oil Herring oil Menhaden oil	Gadus morhua Clupea harengus Brevoortia tyrannus		0 925 <sup>25</sup> 0 900 <sup>60°</sup> 0 903 <sup>60°</sup>	1 481 <sup>25°</sup> 1 4610 <sup>60°</sup> 1 4645 <sup>60°</sup>	165 140 170	186 192 191
10	Sardine oil	Sardinops caerulea		0 90560°	1 4660 <sup>60°</sup>	185	191
11 12 13	Sperm oil, body Sperm oil, head Whale oil	Physeter macrocephalus P. macrocephalus Balaena mysticetus		0 89260	1 460 <sup>60</sup> °	76-88 70 120	122-130 140-144 195
14	Plants Babassu oil	Attalea funifera	22-26	(0 893 <sup>60°</sup> )	1 44360°	15 5	247
15 16 17	Castor oil Cocoa butter Coconut oil	Ricinus communis Theobroma cacao Cocos nucifera	$ \begin{array}{c c} (-18 \ 0) \\ 34 \ 1 \\ 25 \ 1 \end{array} $	0 96115° 0 96415° 0 92415°	1 4770 1 4568 1 4493	85 5 36 5 10 4	180 3 193 8 268
18 19 20 21	Corn oil Cotton seed oil Linseed oil Mustard oil	Zea mays Gossypium hiisutum Linum usitatissimum Brassica hirta	$ \begin{vmatrix} (-20 \ 0) \\ (-1 \ 0) \\ (-24 \ 0) \end{vmatrix} $	() 922 <sup>1</sup> °° () 917 <sup>2</sup> °° () 938 <sup>1</sup> °° () 9145 <sup>1</sup> °°	1 4734 1 4735 1 4782 <sup>25°</sup> 1 475	122 6 105 7 178 7 102	192 0 194 3 190 3 174
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	Neem oil Niger-seed oil Oiticica oil Olive oil Palm oil Palm-kernel oil Perilla oil Poppy-seed oil Rapeseed oil Safflower oil Soybean oil Sunflower-seed oil Tung oil Wheat-germ oil	Melia azadırachta Guizotia abyssinica Licania rigida Olea europaea sativa Elaeis guincensis E. quineensis Arachis hypogaea Perilla frutescens Papaver somniferum Brassica campestris Carthamus tinctorius Sesamum indicum Glycine soja Helianthus annuus Aleurites fordi Triticum aestivum	-3 (-6 0) 35 0 24 1 (3 0) (-15) (-10) (-6 0) (-16 0) (-17 0) (-2 5)	70 917 <sup>13°</sup> 70 925 <sup>13°</sup> 0 974 <sup>23°</sup> 0 918 <sup>15°</sup> 0 915 <sup>15°</sup> 0 913 <sup>15°</sup> 0 913 <sup>15°</sup> 0 915 <sup>15°</sup> 0 925 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 915 <sup>15°</sup> 0 923 <sup>15°</sup> 0 923 <sup>15°</sup>	1 4615 1 471 1 4679 1 4578 1 4569 1 4691 1 481230 1 4685 1 4706 1 462600 1 4646 1 4729 1 4694 1 5174230	71 128 5 140-180 81 1 54 2 37 0 93 4 195 135 98 6 145 106 6 130 0 125 5 168 2 125	194 5 190 189 7 199 1 219 9 192 1 192 1 194 174 7 192 187 9 190 6 188 7 193 1

 $<sup>^1</sup>$  Caproic.  $^2$  Capryli.  $^3$  Capric.  $^4$  Butyric.  $^3$  Decenoic.  $^6$  C $_{12}$  monoethenoic.  $^7$  C $_{14}$  monoethenoic.  $^8$  Gadoleic plus crucic.  $^9$  C $_{12}$  n-pentadecanoic.  $^{10}$  C $_{17}$  margaric.  $^{11}$  12-Methyl tetradecanoic.  $^{12}$  C $_{20}$  polyethenoic.

#### FATS AND OILS

of variables such as source, treatment, and age of a fat or oil Specific Gravity (column D) was calculated at the specified temperature (degrees centigrade) and referred to water at the same temperature, unless otherwise specified Density, shown in parentheses (column D), was measured at the specified temperature (degrees centigrade) Refractive Index (column E) was measured at 50°C, unless otherwise specified

Constituent Fatty Acids, g/100 g total fatty acids

			Satu	rated					Unsatı	ırated	
	Laurie	Myris- tic	Palmı- tıc	Stearn	Ara- chidic	Other	Palmit- oleic	Oleic	Lino- leic	Lino- lenic	Other
	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
1 2 3 4 5 6	2 5	11 1 2 7 1 3 6 3 4 6	29 0 24 0 25 3 17-18 27 4 24 6	9 2 8 4 11 9 2 3 14 1 30 5	2 4	$\begin{array}{c} 2\ 0^{1},\ 0\ 5^{2},\\ 2\ 3^{3} \end{array}$	4 6 5 2 7	26 7 46 9 47 5 74 76 49 6 36 0	3 6 10 2 6 2 5 4 3		3 6 <sup>4</sup> , 0 1 <sup>5</sup> , 0 1 <sup>6</sup> , 0.9 <sup>7</sup> 1 4 <sup>8</sup> , 1 0 <sup>9</sup> , 1 0 <sup>10</sup> , 0 4 <sup>11</sup> 2 5 <sup>8</sup> 0 2 <sup>7</sup> , 2 1 <sup>8</sup>
7 8 9 10 11 12 13	1 16 0 2	5 8 7 3 5 9 5 1 5 14 9 3	\$ 4 13 0 16 3 14 6 6 5 \$ 15 6	0 6 Trace 0 6 3 2	0.6	.} .53	20 0 4 9 15 5 11 8 26 5 15 14 4		8	20 7 29 6	25 4 <sup>12</sup> , 9 6 <sup>13</sup> 30 1 <sup>12</sup> , 23 2 <sup>13</sup> 19 0 <sup>12</sup> , 11 7 <sup>13</sup> , 0 8 <sup>14</sup> 18 1 <sup>12</sup> , 14 0 <sup>13</sup> , trace <sup>7</sup> , 15 4 <sup>15</sup> 1 <sup>13</sup> , 4 <sup>7</sup> , 10 <sup>16</sup> 4 <sup>6</sup> , 14 <sup>7</sup> , 6 5 <sup>16</sup> 13 6 <sup>12</sup> , 5 9 <sup>13</sup> , 2 5 <sup>7</sup> , 0 2 <sup>17</sup>
14 15 16 17 18 19 20 21	44 1	15 4 15 0 1 4 1 4 1 3 <sup>20</sup>	5 5 4	35 4 2 3 3 0 1 1 2 5	0 2 0 4 <sup>19</sup> 1 3 0 5	0 21, 4 82, 6 63 0 51, 5 42, 8 43	0 4	16 1 7 4 35 1 7 5 49 6 22 9 19 0 27 2 <sup>20</sup>	1 4 3 1 2 1 Trace 34 3 47 5 24 1 16 620	47 4 1 8 <sup>20</sup>	$87^{18}$ $0.2^{11}$ $1.1^{11}$ , $1.0^{21}$
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	46 9	2 6 <sup>20</sup> 3 3 <sup>20</sup>   Trace 1 4 14 1	$\begin{array}{c c} -11 & 3^{23} - \\ 6 & 9 \\ 40 & 1 \\ 8 & 8 \end{array}$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c c} 0 & S^{20} \\ 0 & 5^{20} \\ \hline 0 & 1 \\ 2 & 4 \\ \hline 0 & 9 \\ 0 & 9 \end{array} $	272,703	0 4	58 520 30 320 6 2 84 4 42 7 18 5 56 0 17 8 30 120 32 18 6 45 4 28 9 25 1 4 1 28 1	$\begin{bmatrix} 57 & 3^{20} \\ 4 & 6 \\ 10 & 3 \\ 0 & 7 \\ 26 & 0 \end{bmatrix}$	17 5 1 3 4 6 5	51 () <sup>22</sup> 82 5 <sup>21</sup> 3 1 <sup>11</sup> , 1 1 <sup>21</sup> 50 <sup>22</sup> 0 1 <sup>7</sup> 90 7 <sup>23</sup>

 <sup>&</sup>lt;sup>13</sup> C<sub>22</sub> polyethenoic <sup>14</sup> Behenic <sup>15</sup> C<sub>14</sub> polyethenoic <sup>16</sup> Gadoleic <sup>17</sup> C<sub>24</sub> polyethenoic. <sup>18</sup> Riemoleic. <sup>19</sup> Includes behenic and lignoceric <sup>20</sup> Percent by weight <sup>21</sup> Lignoceric <sup>22</sup> Erucic <sup>23</sup> Includes behenic <sup>21</sup> Licanic <sup>25</sup> Eleostearic

### WAXES

These data for waxes were compiled originally for the Biology Data Book by A H Warth Data are reproduced here by permission of the copyright owners of the above publication, the American Societies for Experimental Biology, Washington, D C p 382

Specific Gravity (column C) was calculated at the specified temperature, degrees centigrade, and referred to water at the same temperature Density. shown in parentheses (column C), and Refractive Index (column D) were measured at the specified temperature, degrees centigrade

	Wax	Melting Point °C		pecific G or (Den			n -	lex °C	Iodine Value	Acid Value	Saponifi- cation Value
_	(A)	(B)		(C)			(I	<b>)</b> )	(E)	(F)	(G)
1	Bamboo leaf	79-80	(0	961 <sup>25°</sup> )					7 81	14 5	43 4
2	Bayberry (myrtle)	46 7-48 8	(0	98515°)		1	436800		2 92-3 93	3 5	20 5-21 7
3		62-66		927-0	970 <sup>15°</sup> )	1	439-1	48340°	6 8-16 42	16 8-35 8	89 3-149 0
4	USP	61-69	(0	959-0	975 <sup>15°</sup> )	1	447-1	465650	7-113	17-24	90–96
5	, •	62-65	<i>(</i> )	960-0		ı			6-11	18-24	90-97
6	Candelilla, refined			982-0				46385°		12 7-18 1	1
7	Cape berry	40 5-45 0			00715°)	1	450450		0 6-2 4	2 5-3 7	211-215
8	Carandá	79 7-84 5			001150			.=	8 0-8 9	5 0-9 5	64 5-78 5
9	Carnauba	83-86		990-1	-	1	467-1	47240	7 2-13 5	2 9-9 7	78-95
10	genated			980-0	·		4 55 55 400		2 5-8 5	1 0-5 0	177-181
11 12	Chinese insect Cotton	81 5-84 0 68-71		95915°	97013-	1	457 <sup>40°</sup>		1 4 24 5	0 2-1 5 32	73-93 70 6
13		207-218	1	970-0	075159)				24 5 44 2-53 2 <sup>2</sup>		
14		59 0-72 8	,		915 )	١,	46880°		L	58 6-80 7	1
15		67 5-78 1	١,			1	400		22-23	1	69 8-79 3
16	•	61 5-69 8		908-0	98515°						77 5-101 5
17	Ghedda, E Indian beeswax	1				1	440500		5 6-12 6	5 8-7 9	84 5-118 3
18	Indian corn	80-81							4 22	1 9	120 3
19	Japan wax	48-53	0	975-0 9	99315°				4 5-12 5	6-20	206 5-237 5
20	•	11 2-11 8	0	864-0	899 <sup>25°</sup>	1	$465^{25°}$		81 7-88 42	0 2-0 6	92 2-95 0
21	Madagascar	88							3 2-5 3	17 7-28 0	140 0-159 6
22	Microcrystalline, amber	64-91		913-0 9			424-1	452860	0	0	0
23	white	71-89		928-0 9		1	44180°		0	0	0
24	,	76-86		010-1					13 9-17 6	1	59 4-92 0
25	,	77-84	١.	010-1	030 <sup>25°</sup> )	_			10-14	24-43	72-103
26	0 r	44 0-46 5		985150		1	50220°		115 72	48 3	120 9
27 28		79 0-83 8		053150	200150				6 9-7 82		61 8-85 8
29	Ozocerite, refined Palm	74 4-75 0 74-86		991-1					0 8 9–16 9 <sup>2</sup>	0 10 6	0 64 5–104 0
30	Paraffin, American		٠.	896-0 9		1	442-1	4.4 Q 80°	0 9-10 9-	0	04 5-104 0
31				980 <sup>15°</sup>	020	1	442-1	440	16-40		73 9–136 0
32	•			500		1	469 <sup>30°</sup>		í .	15-17	56 9-104 4
33	Shellac wax	79-82		971-0 9	980150	_	100		6 0-8 83		63 8-83 0
34		74-81		007-1					28-292	16-19²	56-58
35	Sorghum grain	77-82							I	10 1-16 2	ľ
36		7980								25 0	120 4
37	•	42-50		905-0 9	-	1	$440^{70^o}$		4 8-5 9	2 0-5 2	108-134
38		52-67		988-0 9					32-84	24-57	128–177
39	Sugarcane, double- refined			961-0 9	i	1	510250		13–29 	8–23	55–95
40	Wool wax, refined	36-43	0	932-0 9	945150	1	478-1	482400	15 0-46 9	5 6-22 0	80–127

<sup>&</sup>lt;sup>1</sup> Wijs test <sup>2</sup> Hanus test <sup>3</sup> Hubl test <sup>4</sup> Myrica cordifolia

#### DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS

Compiled by George W. Smith

The following table contains values for the molar susceptibility of  $x_M$ , specific susceptibility x and volumetric susceptibility k. The cgs Gaussian system of units is employed. In the Gaussian units the relation between magnetic induction B and magnetic field strength H is

$$B = H + 4\pi I \tag{1}$$

where I is the magnetization or magnetic moment per unit volume. Actually the quantities involved in equation (1) are all vectors but one may assume that all three are collinear a reasonable assumption for organic diamagnetic substances in the liquid state. For crystals I may vary with crystal orientation. Fquation (1) may be rewritten

$$B = H + 4\pi h H = (I + 4\pi h)H$$
 (2)

Here, K is the magnetic susceptibility often called the volumetric susceptibility and is a unities quantity. Other susceptibilities of use to chemists and physicists are the specific or mass susceptibility which is defined.

$$\chi = K/\rho \tag{3}$$

where  $\rho$  is the density of the sample in grams per cc , and the molar susceptibility which is defined as

$$X_{M} = M_{\chi} = M K/\rho \tag{4}$$

where M is the molecular weight of the substance in grams. Temperatures, when listed are enclosed in parentheses and are listed in degrees C. Literature references for values contained in this table may be found in General Motors Research Laboratories publication (AR-317).

Compound	$-x_{\rm W} \times 10^6$	$-\chi \times 10^6$	$-\mathrm{K} \times 10^{6}$	Compound	$-x_{\rm M} \times 10^6$	$-x \times 10^{e}$	$-K \times 10$
Acenaphthanthracene	184	73		Amyl jodide	(118 7)	5996 (18°)	( 910) (20°)
Acenaphthantin acene	109 3	(709)	(726) (99°)	n-Amyl methyl ketone	80 50	7053	( 580) (15°)
Acetal	81 39	688 (32°)	( 568) (32°)	Amyl nitrate	(76.4)	574	( 000) (10 )
kcetaldehyde	22 70	5153	(403) (18°)	iso-Amyl propionate	101 73	705 <sub>4</sub> (25°)	( 609) (25°)
cetamide	34 1	577	( 618) (20°)	n-Amyl valerate	124 55	7239	(638) (0°)
cetic acid	31 54	525 (32°)	( 551) (32°)	Anethole	(96 0)	648	( 644) (15°)
kcetic acid	(52.8)	517		Andine	62 95	(676)	( 691) (20°)
cetoaminofluorene			( 562) (15°)	Anisidine	(80 5)	654	(72) (20°)
	(141) 33 7s	63 581 <sub>4</sub>	( 460) (20°)	Anisole	72 79	(673)	( 672) (15°)
cetone	28 0			Anthanthrene	204 2	739	(0/2)(10)
cetonitrile		( 682)	( 534) (20°)	Anthanthrone	178 1	581	1
cetonylacetone	62 51	5476	( 531) (20°)			731	( 014) (079)
cetophenone	72 05	599 <sub>8</sub>	(615) (20°)	Anthracene	(130)		( 914) (27°)
cetophenone oxime	79 90	5920	[	Anthracenedinitrile	154 6	(678)	
cetophenone oxime-O-methyl ether	92 31	6188	( (00) (000)	Anthracenonitrile	142 1	(700)	( 002) (000)
cetoxime	44 40	6076	(480) (20°)	Anthraquinone	(119 6)	575	( 825) (20°)
cetoxime-O-benzyl ether	104 89	642	1	Anthrazine	245 7	646	(005) (000)
cetoxime-O-methyl ether	54 8	6298		Arabinose	85 70	571	( 905) (20°)
cetylacetone	54 88	5481	( 535) (20°)	Arbutoside	158 0	( 589)	
cetyl chloride	38 9	496	(548) (20°)	Asarone	131 4	(631)	(735) (18°)
cetylene	12 5	(480)	' '	Asparagine	69 5	( 526)	( 812) (15°)
cetylphenylacetylene	86 9	508		Aspartic acid	642±4	(482)	( 800) (12°)
cetylthiophene	71 7	( 568)	Ì	Aurin	(161 4)	556	1
cridine	(123 3)	688	(757) (20°)	p-Azoanisole	(147 7)	610	
donitol	91 30	600	, , , , , ,	Azobenzene	(106 8)	586	611 (70 5°)
lanine	50 5	(567)		p-Azophenetole	(171 7)	635	
llyl acetate	(56.7)	566	(525) (20°)	m-Azotoluene	(127 8)	608	643 (58°)
llyl alcohol	36 70	632	540 (20°)	Azulene	98 5	768	[
-Allylpyrrole	73 80	685 (20°)	(-0)	Barbituric acid (Anh.)	53 8	(420)	<b>\</b>
minoazobenzene	(118 3)	600		Barbituric acid (2H <sub>2</sub> O)	78 6	(4 79)	
minoazotoluene	(142 2)	631		Benzalazine	(123 7)	594	ļ
-Ammoazotoluene	(138)	$61 \pm 02$	ļ	Benzaldehyde	60 78	(573)	( 602) (15°)
-Aminobutyric acid	62 1	(602)		Benzaldoxime	(69.8)	576	(639) (20°)
minomethyldiethyldiazine	114 8	(696)		Benzamide	(72 3)	597	(801) (4°)
-Aminostilbene	122 5	(628)		Benzanthrone	142 9	620	
-Aminothiazole	56 0	564		Benzene	54 84	702 (32°)	611
-Amyl acetate	89 06	684,	5979 (20 7°)	Benzidine	110 9	603	(754) (20°)
o-Amyl acetate	89 40	687	599 (20°)	Benzil	(118 6)	564	616 (100°)
-Amyl alcohol	(67 5)	766	( 624) (20°)	Benzoic acid	70 28	(575)	(728) (15°)
-Amyl alcohol	(71 0)	8060	(655) (25°)	Benzoic anhydride	(124 9)	552	( 662) (15°)
active Amyl alcohol	69 06	783 <sub>4</sub> (25°)	( 000) (20 )	Benzonitrile	65 19	(632)	( 638) (15°)
o-Amyl alcohol	68 96	782 <sub>3</sub> (25°)	( 64) (15°)	Benzophenone	109 60	6013	(66) (50°)
c-Amyl alcohol	69 1	785	(635) (20°)	3.4-Benzopyrene	135 7	538	( 00) (00 )
rt-Amyl alcohol	(70 9)	804	(654) (15°)	Benzopyrene	194 0	000	
Amylamine	69 4	(796)	( 606) (20°)	Benzoyl acetone	(95 0)	586	(639)(60°)
Amylamine o-Amylamine	71 6	(821)		Benzovi chloride	(75.8)	539 (20°)	(657) 15°)
Amylamine Amylbenzene	112 55	( 759)	( 616) (20°) ( 652) (20°)	Benzyl acetate	93 18	(620)	( 655) (16°)
	(88 7)			Benzyl alcohol	71 83	(664)	(697) (15°)
-Amyl bromide	113 52	587 717 <sub>4</sub> (25°)	(706) ·20°)	Benzylamine	75 26	(702)	(690) (19°)
-Amyl-n-butyrate			( 616) (25°)	Benzyl chloride	81 98	(647)	(713) (18°)
-Amyl chloride	(79 0)	741	( 662) (20°)	Benzyl formate	81 43	(598)	(646) (20°)
o-Amyl cyanide	73 4	( 755)	( 609) (20°)	Benzyl formate Benzylideneaniline	(100 4)	554	( 040) (20 )
o-Amvlene	53 7	766				608	( 763) (14°)
mylene bromide	(114 5)	498		Benzylidene chloride	(97 9) (73 1)	613	(100)(14)
mylene chloride	(95 2)	675	( 000) (400)	Benzylidenemethylamine	(73 1)		( 624) (20°)
o-Amyl ether	(129)	813	( 635) (15°)	Benzyl methyl ketone	83 44	6219	
o-Amyl formate	78 38	674s	( 591) (25°)	Bibenzyl	(126 8)	696	671 (54 5°)
mylidene chloride	(93.4)	662	Ï	i e e e e e e e e e e e e e e e e e e e	1 1		

Compound	$-x_{M} \times 10^{6}$	$-\chi \times 10^6$	-K × 10 <sup>6</sup>	Compound	$-x_{\rm H} \times 10^6$	$-\chi \times 10^6$	- K × 10€
,4-Bis (p-hydroxyphenyl)-2,4-hexadie		59		Chlorofumarie acid	67 02	( 445)	
n,m -Bitolyl n,m'-Bitolyl sulfide	(127 4) (140 0)	6993 (27 4°) 6530 (27 4°)	( 699) (16°)	p-Chloroiodo benzene Chloromaleic acid	99 42 67 36	( 417) ( 448)	( 786) (57°)
orneol	126 0	(817)	( 826) (20°)	Chloromethy Istilbene	144 8	( 633)	
romobenzene	78 92	5030 (20°)	( 753) (20°)	a-Chloronaphthalene	107 60	661	789 (20°)
romobenzenediazoci anide romochloromethane	86 88 55 0 ± 6	( 414) ( 425)	( 846) (19°)	m Chloronitrobenzene o-Chlorophenol	(74-8) 77-4	475 (602)	638 (48°) (747) (18°)
Bromodichloromethane	66 3 ± 3	(405)	( 812) (15°)	p-Chlorophenol	77 6	(604)	( 789) (20°)
romoform romonaphthalene	82 60 (123 8)	327 598	948 (20°)	1-(o-Chlorophenylazo) 2 napthol 1 (p-Chlorophenylazo) 2 napthol	161 0 161 4	( 570) ( 571)	
-Bromonaphthalene	115 90	560	840 (20°)	Chlorotrifluoroethy lene	49 1	422	
n-Bromotoluene Bromotrichloromethane	(93 4) 73 1 ± 7	546 ( 369)	( 770) (20°) ( 758) (0°)	Chlorotrifluoromethane Cholesterol	$(284\ 2)$	( 434) 735	( 784) (20°)
utane	57 4	(988)	(130)(0)	Chrysene	166 67	731	(104) (20)
so-Butane 4-Butanediol	51 7 61 5	(890)	( 000) (000)	Chrysoidine Cinnamic acid	(126 3) 78 36	595 529	( 660) (4°)
-Butene (cis)	42 6	( 682) ( 759)	( 696) (20°)	Cinnamic acid (a trans)	78 2	( 528) ( 533)	( 000) (4 )
Butene (trans) Butene 3 4-diacetate	43 3	(772)		Cinnamic acid (\$\beta\$ trans)	79 0	( 533) ( 524)	
Butene-1 4 diacetate (cis)	95 5	( 555) ( 553)		Cinnamic acid (cis MP 68°) Cinnamic acid (cis-MP 58°)	77 6 77 9	(526)	}
-Butene 1.4 diacetate trans)	95 1	(552)		Cinnamic acid (cis-MP 42°)	83 2	(562)	( 000) (170)
Butene 1.4 diol (cis) Butene 1.4 diol (trans)	54 3 53 5	( 616) ( 607)		Cinnamic aldehyde Cinnamil alcohol	(74 8) (87 2)	566 650	( 629) (15°) ( 679) (20°)
Butvl acetate	77 47	666 <sub>9</sub> (25°)	( 583) (25°)	Cinnamylideneaniline	123 2	(595)	
o Butyl acetate Butyl alcohol	78 52 56 536 (20°)	6769	( 584) (25°)	Citral	(98 9) (243 3)	650 810	( 577) (20°)
o-Butyl alcohol	57 704 (20°)	( 7627) ( 7785)	( 6176) (20°) ( 624) (20°)	Coronene Coumarin	82 5	( 565)	( 528) (20°)
c Butyl alcohol	57 683 (20°)	(7782)	(629) (20°)	o-( resol	72 90	675 667 (26°)	( 706) (20°) ( 690) (20°)
rt-Butyl alcohol -Butylamme	57 42 58 9	774 (25°) (805)	( 611) (20°) ( 596) (20°)	m Cresol p-Cresol	72 02 72 1	667 (26°)	( 690) (20°)
o-Butylamine	59 8	(818)	( 599) (20°)	o-Cresvimethyl ether	81 94	671 (40°)	(661) (15°)
Butvl anthracene Butvlbenzene	176 0 100 79	( 751) ( 751)	( 646) (20°)	m Crest Imethyl ether p-Crest Imethyl ether	77 91 79 13	638 (40°) 648 (40°)	( 623) (15°) ( 629) (19°)
-Butylbenzene	101 81	(759)	(648) (20°)	Cumene	89 53	7449	(642)
rt Butylbenzene Butyl benzoate	102 5 116 69	(764)	( 662) (20°) ( 656) (25°)	Cvamelide Cvameluric acid	(56 1) 101 1 (10°)	435 ( 457)	490) (15°)
utvl bromide	77 14	654s 563 (20°)	(730) (20°)	9-Cyanoanthracene	142 1	(699)	
o-Butvl bromide n Butvl chloride	79 88	583 (20°)	(737) (20°)	Cvanogen	(21 6)	415 476	(359) (liq
n-Butyl chloride	67 10 67 40	725 728	642 (20°) 635 (20°)	Cyanuric acid Cyclobutanecarboxylic acid	61 5 58 16	5816 (30°)	( 842) (t/°) ( 613) (30°)
Butvl cyanide	(62.8)	7558 (27 4°)	(606) (20°)	1 3-Cyclohexadiene	48 6	(607)	(510) (20°)
rt-Butvl evelohevane 4-Butvl diacetate	115 09 103 4	8205 ( 594)	6670 (20°)	1,4-Cyclohexadiene Cyclohexane	48 7 68 13	( 608) 8100 (27 5°)	( 515) (20°) ( 627) (20°)
Butyl ethyl ketone	80 73	707-	( 579) (20°)	Cyclohexanecarboxylic acid	83 24	6499 (30°)	( 668) (30°)
Butvl formate o Butvl formate	65 83	614	( 571) (25°)	Cyclohexanol	73 40 62 04	732 632 <sub>3</sub>	694 (20°) (599) (20°)
o Butvlideneazme	66 79 (95 8)	654 <sub>9</sub> 683	( 574) (25°)	Cyclohexanone Cyclohexanone oxime	71 59	632ı	( 333) (20 )
utyl iodide	(93 6)	5086 (18°)	( 822) (20°)	Cyclohevanoneoxime O-methyl ether	82 96	6523	( 507) (909)
o-Butvl methvl ketone rt-Butvl methvl ketone	70 05 69 86	699 <sub>3</sub> 697 <sub>9</sub>	( 561) (20°) ( 558) (16°)	Cyclohexene Cyclohexenol	57 5 64 1	(700) (653)	( 567) (20°)
Butyl perfluor n-butyrate	126 7	(469)		Cyclooctane	91 4	(815)	(684) (20°)
tert Butylphenol utyl sulfide	108 0 (113 7)	( 719) 7774 (27 4°)	( 653) (114°) ( 652) (16°)	Cyclooctene Cyclooctatetraene	84 6 (53 9)	( 769) 518	( 654) (20°)
utyl thiocyanate	(79 38)	6891 (27 4°)	( 659) (25°)	Cyclopentane	59 18	8439	6290 (20°)
Butyne 1 4 diacetate Butyne 1 4 dibenzoate	95 9 169 0	(564) (561)		Cyclopentanecarboxylic acid Cyclopentanone	73 48 51 63	6446 (30°) 6141 (30°)	( 677) (30°) ( 582) (30°)
Butvne-1 4-diol	50 3	(584)		Cyclopropane	39 9	(948)	$(683)(-79^{\circ})$
Butvraldehvde o-Butvraldehvde	46 08	6394	( 522) (20°)	Cvelopropanecarboxylic acid	45 33 102 8	5271 (30°) 766 (20°)	( 569) (30°) ( 656) (20°)
Butyraldovime	46 38 56 1 <sub>°</sub>	643 <sub>4</sub> 644 <sub>3</sub>	( 511) (20°) ( 576) (20°)	p-Cymene Decalin	106 70	700 (20 )	6814 (20°)
Butyric acid	55 10	625	598 (20°)	cis Decalin	(107 0)	774	( 686) (35°)
Butvrie acid itvronitrile	56 06 49 4	636 <sub>3</sub> (25°) (715)	( 601) (25°) ( 569) (15°)	trans-Decalm n-Decane	(107 7) 119 74	779 ( <b>8416</b> )	( 670) (35°) ( 6143) (20°)
tvrvlphenvlacetvlene	(106 4)	618		1-Deuterio pyrrole	48 75	716 (20°)	
.codvl .codvlic acid	(99 9) (79 9)	476 579	( £89) (15°)	Deuteroindene Diacetal	80 88 (153 8)	690 668	( 692) (13°)
mphor	(103)	68	( 67) (25°)	Di-iso-amylamine	[(133 1)	846	( 649) (21°)
mphoric acid mphoric anhydride	129 0	(644)	( 791) (20°)	Diazoacetic ester Dibenzocoronene	57 289 4	( 50) 778	(54) (24°)
aproic acid	(113) 78 55	620 676•	( 740) (20°) ( 624) (25°)	1 2,5 6 Dibenzofluorene	184	69 ± 03	
provlphenvlacetylene aprylic acid	(130 4)	651		3,4 5,6-Dibenzophenanthrene	(203)	73 ± 03	
rbanilide	101 60 134 05	7053 (6316)	( 642) (20°) ( 783) (20°)	Dibenzphenanthrone Dibenzpyrene	200 5 213 6	716 706	
rbazole	117 4	(702)	, , ,	Dibenzpyrenequinone	183 1	551	
rbon disulfide rbon tetrabromide	93 73	554 2826 (20°)	699) (22°)	iso-Dibenzpyrenequinone Dibenzyl ketone	194 6 131 70	586 626∘	
rbon tetrachloride	66 60	433	( 966) 691 (20°)	p-Dibromobenzene	(101 4)	430	786 (100°)
rbon tetraiodide rvacrol	(136)	261	1 13) (20°)	2,3 Dibromo-2-butene-1,4-diol	94 2	( 383) ( 334)	( 808) (25°)
rvone	(109 1) (92 2)	726 614	( 709) (20°) ( 590) (20°)	Dibromodichloromethane 1,2-Dibromodiiodoethylene	$\begin{bmatrix} 81 \ 1 \pm 4 \\ (140 \ 1) \end{bmatrix}$	320	( 808) (20 )
tyl alcohol	(183 5)	757 (17 5°)	( 619) (50°)	1,2-Dibromoethylene	(71 7)	386 379	( 877) (17.5°)
tal mercaptan loral	390 4 (67 7)	1 510) 459	( 694) (20°)	1,2-Dibromo-2-fluoroethane Dibromo-4-nitrophenol	(78 0) (167 5)	564	( 855) (17°)
loranil	(112 6)	458		1,2-Dibromotetrachloroethane	(126 0)	387	(1 049) ( 767) (20°)
loracetic acid loroacetone	48 1 (50 9)	( 509) 550	( 804) (20°) ( 633) (20°)	Di-n-butvlamine Di iso-butvlamine	103 7 105 7	( 802) ( 817)	( 767) (20°) ( 609) (20°)
loroacet i lchloride	53 7	( 475)	( 710) (0°)	Di-sec-butylamine	105 9	(819)	$(641)(0^{\circ})$
hloranisole	891	(625)		Di-iso-butyl ketone	104 30	7335	(591) (20°)
lorobenzene loropenzene diazocyanide	69 97 65 02	( 6216) ( 393)	( 688) (20°)	Di-tert-butvl ketone 2 6-Di-tert-butvl-4-methyl phenol	104 06 165 3	732 <sub>t</sub> ( 750)	
lorodibromomethane	751 ± 4	( 361)	( 883) (15°)	2,4-D1-tert-butyl phenol	155 6	(754)	( 0.00) (0.00)
llorodifluoromethane hloro-2 3-dihydroxypropane	38 6 (77 9)	446 604	•	Dibutyl phthalate Di-iso-butyralacetylene	175 1 (125 6)	( 629) 738	( 657) (21°)
lorodiphenylmethane	131 9	(651)		Dicetvl sulfide	401 7	(832)	
loroethylene loroform	35 9	574	( 528) (liq , 15°)	Dichloroacetic acid	58 2	(451)	( 705) (20°)
111 P C 1 C 1 C 1 C 1 C 1 C 1 C 1 C 1 C	59 30	497	740 (20°)	Dichloroacetyl chloride	69 0	(468)	

Compound	$-x_{\text{M}} \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-x_{\rm M} \times 10^6$	$-\chi \times 10^6$	-K × 10
Dichlorobenzene	84 26	5734	( 748) (20°)	2,5-Dimethylpyrrole	71 92	756 (20°)	( 707) (20°)
-Dichlorobenzene	83 19	5661	(729) (20°)	α ω-Dimethyl styrene	(90 7)	686	
Dichlorobenzene	82 93	5644	( 823) (20 5°)	Dimethyl succinate Dimethyl sulfate	81 50 (62 2)	5581 493	( 625) (18°) ( 657) (20°)
4-Dichloro-2-butyne 2-Dichloro-1,2-dibromoethane	74 2 (108 6)	( 603) 423	1	Dimethyl sulfide	(44 9)	723	( 612) (21°)
1-Dichloro-difluoroethylene	60 0	451		Dimethyltrichloromethylcarbinol	(105)	59	
ichlorodifluoromethane 1-Dichloroethylene	52 2 49 2	432 508	( 642) (-30°) ( 635) (15°)	N.N-Dimethyl urea N.N'-Dimethyl urea	55 1 56 3	( 625) ( 639)	( 784) ( 730)
1-1,2-Dichloroethylene	51 0	526	( 679) (15°)	o-Dinitrobenzene	65 98	3921	( 614) (17°)
ans 1,2-Dichloroethylene	48 9	504	( 638) (15°)	m-Dinitrobenzene	70 53 68 30	4197 4064	( 659) (0°) ( 660) (30°)
3-Dichloro-2-hydroxypropane icyandiamide	(80 1) 44 55	621 (530)	( 742) (14°)	p-Dinitrobenzene 2,4-Dinitrophenol	(73 1)	397	( 668) (24°)
cyclohexanol acetylene	(151 6)	682	(112)(11)	Dinitroresorcinol	(62 4)	312	1
cyclohexyl	129 31	7776	6889 (20°)	1,4-Dioxane	52 16	592 (32°)	( 606) (32°)
l-Dicyclohexylnonane ethanolacetylene	231 98 (75 3)	7930 660	7001 (20°)	Diphenyl 1,1-Diphenylallyl-3-chloride	103 25 146 1	6695 (639)	( 664) (73°)
ethyl acetaldehyde	70 71	705 <sub>9</sub>	( 576) (20°)	1,3-Diphenylallyl-3-chloride	140 7	(615)	
ethylallylacetophenone	146 2	(676)	( 663) (16°)	Diphenylamine	(109 7)	648	686 (55 5°
ethyl allylmalonate ethylamine	118 8	( 593) ( 777)	( 602) (14°)	Diphenyl-bis-diazo cyanide Diphenylbutadiene	85 03 129 6	( 327) ( 629)	
ethylcyclohexylamine	56 8 (124 5)	802	( 552) (18°) ( 699) (0°)	Diphenylchloroarsine	(145 5)	550	( 871) (40°)
ethyl ethylmalonate	115 2	(612)	( 614) (20°)	Diphenyldecapentaene	180 5	(635)	
ethyl ketone	58 14	6751	( 551) (19°)	Diphenyldiacetylene Diphenyldiazomethane Diphenyldihydrotetrazine	(134 6) 115	640 ( 592)	ļ
ethyl ketoxime ethyl malonate	68 3 <sub>1</sub> (92 6)	6754 5782	( 611) (20°)	Diphenyldihydrotetrazine	129 9	(545)	ļ
ethyl-3-(1-methyl butane) ethyl-	(92 0)	5102	(011) (20)	[1,1 Diphenylethylene	(1180)	655	( 680) (14°)
malonate	175	(677)	( )	1,6-Diphenylhexane	171 81	7208	6877 (20°)
ethyl oxalate ethyl phthalate	81 71 127 5	5595 (574)	( 603) (15°) ( 645) (25°)	Diphenylhexatriene Diphenylmethane	146 9 (115 7)	( 632) 688	684 (35 5°
ethyl sebacate	(177 0)	685	( 661) (20°)	Diphenylmethanol	119 1	647	1
ethylstilbestrol	172 0	(547)	( ) / ( / )	1,1-Diphenylnonane	206 32	7357	6935 (20°)
ethylstilbestrol dipropionate ethyl succinate	265 2	720	( 000) (000)	Diphenyloctatetraene Diphenylphenoxyarsine	164 3 (225 2)	( 636) 567	
ethyi succinate ethyl sulfate	105 07 (86 8)	6035 563	( 628) (20°) ( 667) (15°)	N.N-Diphenyl urea	126 3	(595)	( 759)
ethyl sulfide	(67 9)	753	(630) (20°)	N.NDiphenyl urea Di-n propyl ketone	127 5	(600)	( 743) (20°)
ethyl tartrate	(113 4)	550	( 662) (20°)	Di-n propyl ketone	80 45	705 <sub>0</sub>	( 576) (20°) ( 573) (20°)
fluoroacetamide Difluoro-2-dibromoethane	(41 2) (85 5)	433 382	( 883) (20°)	Di iso-propyl ketone Dipropyl oxalate	81 14 105 27	$711_0$ $6046$	(628) (0°)
-Difluoro-2,2 dichloroethyl amyl ether	129 84	(587)	(694) (20°)	Di iso-propyl oxalate	106 02	6089	1
Difluoro-2,2-dichloroethyl butyl				Dodecyl alcohol	147 70	7849 (20 7°)	( 652) (24°)
other	119 48	(577)	( 703) (20°)	Duleitol	112 40 204 8	617 ( 725)	( 905) (15°) ( 619) (79°)
-Difluoro-2 2-dichloroethyl ethyl ether -Difluoro-2,2-dichloroethyl methyl	96 13	(537)	( 723) (20°)	Flaidic acid Erythritol	73 80	604	( 876) (20°)
ether	80 68	(489)	( 696) (20°)	Ethane	73 80 27 3	(910)	( 511) (-10
-Difluoro-2,2-dichloroethyl propyl				4-Ethoxy-3-methoxybenzyl acetate	138 5	619	
ether fluoroethanol	107 19	( 555) 503	( 701) (20°)	4-Ethoxy 3-methoxybenzyl benzoate 1-Ethoxynaphthalene	177 3 119 9	620 ( 696)	( 738) (20°)
nuoroethanor -n-heptylamine	(41 3) 171 5	(805)		2-Ethoxynaphthalene	119 2	( 692)	( 734) (25°)
-n-hevylamine	148 9	(803)	ì	Ethyl acetate	54 10	614	554 (20°) ( 565) (20°)
hydronaphthalene	(85 1)	654	( 652) (12°)	Ethyl acetoacetate	71 67 95 5	550s ( 644)	( 639) (16°)
Dimethoxybenzene Dimethoxybenzene	87 39 87 21	6329 6316	( 686) (25°) ( 682) (0°)	Ethylacetophenone Ethyl alcohol	33 60	728	575 (20°)
Dimethoxy benzene	86 65	6275	( 661) (55°)	Tthylally acetophenone	122 5	(651)	( 634) (16°)
2,5-Dimethoxybenzoyl)-benzoic acid	161 0	(.562)		Fthyl amylpropiolate	(112 7)	670	( 700)
methoxymethane methylacetophenone	(47 3) 96 8	621 ( 653)	(532)	Fthylandine 9-Ethyl anthracene	89 30 153 0	(737) (741)	( 709)   ( 771) (99°)
methylallylacetophenone	90 8 122 4	(650)	( 645) (16°) ( 635) (16°)	Ethylbenzene	77 20	7272	6341 (20°)
methylaniline	89 66	(740)	( 00 ) (10 )	Ethyl benzoate	93 32	6211	( 648) (25°)
-Dimethylbutane	76 24	8848	5744 (20°)	Fthyl benzoylacetate Fthyl benzylidenecyanoacetate	(115 3) (116 3)	600 578	( 673) (20°)
-Dimethylbutane -Dimethyl-2-butene	76 22 65 9	8845 ( 783)	5853 (20°) ( 557)	Fthyl benzylmalonate	(154 5)	6172	( 663) (20°)
methylcyclohexanone	(84.8)	672	( 331)	Fthyl bromide	54 70	502	719 (20°)
and 1 3 Dimethylcyclopentanes	81 31	8281	6224 (20°)	I thyl bromoacetate	(82 8)	496 652	( 747) (20°)
-Dimethyl-2,5 dibromo-3-hexine nethyl diethylketo tetrahydro-	(135 6)	506	ļ	Fthvl-1-isobutvlacetoacetate Ethyl butylmalonate	(121 4) 139 3	644	( 629) (20°)
urfurane	(116 2)	753		Ethyl n-butyrate	(77.7)	6693	(25°)
Dimethyl 1-ethylpyrrole	94 61	768 (20°)		Fthyl iso-butyrate	78 32	6743	( 583) (25°)
-Dimethyl 3-ethylpyrrole -Dimethylfuran	93 87	762 (20°)	( 690) (100)	Ethyl chloroacetate Fthyl cinnamate	(72 3) (107 5) (45 6) (67 3)	590 610	( 684) (20°) ( 640) (20°)
nethylluran nethyl furazan	66 37 57 27	687 (20°) 584	( 620) (18°)	Fthyl cliniamate   Ethyl-iso-cyanate	(45 6)	642	( 582) (16°)
Dimethyi-4-heptene	100 6	(797)	ļ	Ethyl cyanoacetate	(67 3)	595	( 632) (20°)
Dimethyl-2,4-hexadiene	(78.7)	714	0104 0000	Fthylcyclonexane	91 09	8118	6324 (20°) ( 636) (16°)
Dimethylhexane Dimethylhexane	98 77 98 15	8648 8593	6164 (20°) 5969 (20°)	Lthyldiallylacetophenone Ethyl dibromocinnamate	147 4 174 5	( <b>646</b> ) 519	, , ,
Dimethylhexane	99 06	8673	6240 (20°)	I thyl dichloroacetate	85 2	( 543) 6328	( 696) (20°)
Dimethyl-4 hexanol	116 9	812	' ' '	Fthyl diethylacetoacetate	(117 9)	6328	( 615) (20°) ( 641)(20°)
Dimethyl 3 hexine-2,5-diol	(103 0)	724		I thyl diethylmalonate Fthyl dithiolacetate	(140 4) (71 0)	6492 5904 (27 4°)	
nethyl isoxazole nethylketo tetrahydrofurfurane	59 7 (68 5)	( 615) 600	1	Fthyl dithiolacetate   Fthylene	12 0	(428)	(242) (-10
nethyl malonate	69 69	5277	( 609) (20°)	Ethylene	15 30	546 (32°)	( 242) (-10 ( 309) (-10 915 (20°)
Dimethylnaphthalene	113 3	(725)		Ethylene bromide	78 80 59 62	419 602 (32°)	910 (20°) ( 757) (20°)
Dimethylnonane Dimethylnonane	134 68 134 70	( 862) ( 862)	( 636) (20°) ( 647) (20°)	Ethylene chloride Ethylenediamine	59 62 46 26	771 (32°)	( 757) (20°) ( 686) (20°)
Dymothylponono	124 50	( 861)	( 647) (20°)	Ethylene iodide	104 7	371 (32°)	( 791) (10°)
Dimethyl-2,6,8-nonatriene	(108 8)	724 990	,,	Ethylene oxide	30 7	( 697) 743	( 618) (7°)
nethyl-2,4-nonatriene	(148 8)	990	( 607) (009)	Fthyl ether	55 10 93 9	743 5937	534 (20°) ( 582) (20°)
Dimethyloctane	(108 8) (148 8) 122 54 57 17	( 861) 583 472	( 627) (20°)	Ethyl etnylacetoacetate Ethyl ethylbutylmalonate	(163 3)	6683	(650) (20°)
Dimethyloxadiazole nethyl oxalate	(55.7)	472	( 542) (54°)	Ethyl ethylpropylmalonate	(152 4)	6619	(648) (20°)
nethyl oxamide	(63 2) 86 97	544		Ethyl formate Ethyl hexylpropolate Ethyl hydroxylamine	43 00	580	531 (20°)
-Dimethylpentane	86 97	8680	5849 (20°) 6070 (20°)	Ethyl hexylpropolate	129 9 (43 0)	713 704	
Dimethylpentane Dimethylpentane	87 51 87 48	8733 8732	5876 (20°)	Ethyl hydroxylamine Ethylidene chloride	(57 4)	580	( 681) (20°)
-Dimethylpropane	63 1	(875)	( 536) (0°)	Ethyl iodide	(57 4) (69 7)	4470 (17 5°)	( 864) (20°)
Dimethyl-3-propyl-pyrrole	106 07	773 (20°)	Į.	Ethyl iodoacetate	(97 6)	456	( 829) (13°) ( 633) (25°)
-Dimethylpyrrole	69 64	732 (20°)	( 679) (14°)	Ethyl lactate	(72 6)	615	- ( Doo o ) (25°)

Compound	$-x_{\rm M} \times 10^6$	$-\chi \times 10^g$	-K × 10 <sup>6</sup>	Compound	$-x_{\rm M} \times 10^6$	$-\chi \times 10^6$	-K × 10 <sup>6</sup>
Ethyl methylacetoacetate Ethyl methyl ketoxime	(81 9)	5684	( 569) (20°)	Indene (natural) Indene (synthetic)	84 79 80 89	( 730) ( 696)	( 723) 25°) ( 690) (25°)
Ethyl-1-methyl-2-oxocyclohexane-	57 32	6580	( 530) (20°)	Indole	85 0	( 726)	
carboxylate Ethyl methylphenylmalonate	112 1 (153 2)	( 608) 6121	( 658) (20°)	lodobenzene lodoform (m sol'n)	92 00 117 1	451 2974 (20°)	826 (20°) (1 192) (17°)
Ethyl nitrophenylpropiolate Ethyl oxamate	114 6 62 0	523	( 427) (19°)	1 Iodo-2 phenylacetylene o Iodotoluene	(110 1) (112 2)	483 5145 (30°)	( 874) (20°)
Ethyl perfluor-n-butyrate	103 5	( 427)		m-Iodotoluene	(112 3)	5152 (30°)	( 875) (20°)
Ethyl phenylacetate Ethyl phenylmalonate	104 27 (142 2)	( 635) 6017	( 656) (20°) ( 659) (20°)	p-Iodotoluene Leucine	101 31 84 9	(465) (647)	( 780) (40°)
Ethyl phenylpropiolate Ethyl phosphate	(104 2) (98 2)	598 539	( 636) (13°) ( 576) (25°)	Iso-Leucine Maleic acid	84 9 49 71	( 647)   ( 428)	( 681) (20°)
Ethyl propionate Ethyl propylacetoacetate	(66 5) (105 7)	6514 6135	( 584) (15°) ( 593) (20°)	Maleic anhydride Malonic acid	(35 8) (46 3)	365 4453	( 341) (20°) ( 726) (15°)
Ethyl-n-propyl ketone	69 03	689 <sub>1</sub>	( 560) (22°)	Mannitol	111 20	610	( 908) (20°)
Ethyl succinimide Ethyl sulfine	(72 0) (67 0)	566 631		Mannose Mesitylene	102 90 92 32	571 7682 (20°)	( 879) ( 665) (20°)
Ethyl sulfite Ethylsulfone ethyl ether	(75 4) (81 8)	546 592	( 604) (0°)	Methane Methione	12 2 <sub>7</sub> 91 0	(765) (610)	
Ethyl thiocyanate Ethyl isothiocyanate	(55 7)	6392 (27 4°)	( 637) (25°) ( 680) (15°)	p-Methoxyazobenzene o-Methoxybenzaldehyde	(118 9) 76 0	560	( 632) (20°)
Ethyl thiolacetate	(59 0) (62 7)	6772 (27 4°) 6019 (27 4°)	( 586) (25°)	p-Methoxybenzaldehyde	78 0	(558) (572)	(642) (20°)
Ethyl thionacetate Ethyl tribromoacetate	(63 5) (119 5)	6098 (27 4°) 368	( 821) (20°)	o-Methoxybenzvl alcohol 1-Methoxynaphthalene	87 9 107 0	637 (676)	( 664) (25°) ( 741) (14°)
Ethyl trichloroacetate N-Ethyl urea	(99 6) 55 5	520 (630)	(719) (20°) (764) (18°)	2-Methoxynaphthalene 1 (o-Methoxyphenylazo)-2-naphthol	107 6 163 6	( 680) ( 588)	( , ( ,
Ethyl iso valerate	(91 1)	700	( 607) (20°)	Methoxysaligenin acetate	110 3	613	FOT (200)
Eucalyptol Eugenol and iso-eugenol	(116 3) (102 1)	754 622	( 699) (20°) ( 663) (20°)	Methyl acetate Methyl acetoacetate	42 60 59 60	$\begin{array}{c} 575 \\ 513_2 \end{array}$	537 (20°) ( 553) (20°)
Flavanthrone Fluorene	241 0 110 5	590 655		Methylacetylacetone Methyl alcohol	(65 0) 21 40	569 668	530 (20°)
Fluorenone	99 4	552	( 623) (100°)	Methylallylaketone	111 9	(1.330)	
Fluorobenzene Fluorobromoacetic acid	(58 4) (59 5)	608 379	( 623) (20°)	Methylamine N Methylaniline	(27 0) 82 74	870 ( 773)	( 608) (-11°) ( 762) 20°)
Fluorodichloromethane	48 8 (88 0)	474 628	( 676) (0°)	9-Methylanthracene Methyl benzoate	146 5 81 59	762) 599 <sub>3</sub>	( 812) (99°) ( 651) (25°)
p-Fluorophenetole Fluoro trichloroethylene	72 5	485	( 742) (25°)	Methyl-o-benzoylbenzoate	139 4	(580)	( 690) (19°)
Fluorotrichloromethane Formaldehyde	58 7 (18 6)	427 62	( 638) (17°) ( 51) (-20°)	Methylbenzylaniline Methyl bromide	(132 2) 42 8	670 451	(1 044) (0°)
Formamide Formic acid	(21 9) 19 90	486 432	( 551) (20°) 527 (20°)	2-Methylbutane 2-Methyl-2-butene	64 40 54 14	8925 ( 772)	5531 (20°) ( 516) (13°)
β-Formylpropionic acid	55 3	( 542) 570	021 (20 )	Methyl butyl ketone	(69 1)	690	( 563) (15°)
Fructose Fulvene (Benzene XM measured to be 49)	102 60 42 9	(549)	( 452) (20°)	Methyl iso-butyl ketone Methyl tert-butyl ketone	(69 3) (70 4)	692 703	( 554) (20°) ( 562) (16°)
Fulvene $\left(\chi \frac{54.8}{49}\right)$	48 0	( 614)	( 505) (20°)	p-Methyl-o-tert butylphenol Methyl butyrate	120 3 (66 4)	( 732) 6498	( 588) (16°)
Fumaric acid	49 11	( 423)	( 692) (20°)	o-Methylcarbanilide Methyl chloride	154 0 (32 0)	( 681) 633	(, ( ,
Furan Furfural	43 09 47 1	633 (20°) ( 490)	( 598) (15°) ( 568) (20°)	Methyl chloroacetate	58 1	(535)	( 661) (20°)
Galactose Gallic acid	103 00 90 0	572 (529)	( 896) (4°)	Methylcholanthrene 3-Methylcholanthrene	(182) 194 0	68 ± 04 (723)	
Geraniol formate	(119 9)	658	( 610) (20°)	Methylcyclohexane 2-Methylcyclohexanone	78 91 (74 0)	8038 660	6181 (20°) ( 610) (18°)
Glucose D-Glucose	102 60 101 5	570 ( 563)	( 869) (25°)	3-Methylcyclohexanone	(74.8)	667	(610) (20°)
Glutamic acid Glycerol	78 5 57 06	(533) 619	779 (20°)	4-Methylcyclohexanone Methylcyclopentane	(63 5) 70 17	566 8338	( 516) (24°) 6245 (20°)
Glycine	403	( 537)	( 846) (50°)	4-Methyl-2,6-di tert-butvlphenol Methyl dichloroacetate	167 6 73 1	( 761) ( 511)	
Glycol Guaiacol	38 80 (79 2)	624 638	698 (20°) ( 720) (21°)	Methyldiphenoxyphosphine oxide	73 t (152 9)	616	
Helianthrone 1,2-Heptadiene	189 9 73 5	497 (764)		Methyldiphenyltriazine Methylene bromide	(155 1) 65 10	627 375	935 (20°)
2,3-Heptadiene Heptaldehyde	72 1 81 02	(749)	( 603) (008)	Methylene chloride Methylene iodide	(46 6) 93 10	549 348	( 733) (20°) 1 156 (20°)
n-Ĥeptane	85 24	709 <sub>6</sub> 8507	( 603) (20°) 5817 (20°)	Methylene succinic acid Methyl ether	57 57 26 3	( 443) 571	(723)
4-Heptanol n-Heptanoic acid	91 5 88 60	789 680	( 647) (20°) 626 (20°)	Methylethylallyacetophenone	133 3	(659)	( 643) (16°)
n-Heptyl amine	93 1 134 41	( 808) 7625	( 628) (20°) 6528 (20°)	Methyl ethyl ketone Methyl formate	45 5s (32 0)	632• 5327	( 509) (20°) ( 519) (20°)
n-Heptyl benzene Heptyl cyclohexane	147 40	8084	6559 (20°)	Methylfumaric acid 3-Methylheptane	56 98 97 99	( 438) 8580	( 642) 6056 (20°)
n-Heptylic acid 1-Heptyne 2 Heptyne	89 74 77 0	6900 ( 801)	( 630) (25°) ( 584) (25°)	2-Methyl-4 heptene 5-Methyl-1,2 hexadiene	88 0	(784)	
2 Heptyne Hexabromoethane	79 5 (148 0)	( 826) 294	( 615) (25°) (1 124) (20°)	2-Methylhexane	73 6 86 24	( 765) 8607	( 553) (19°) 5841 (20°)
Hexachlorobenzene	(147 5)	518	(1 059) (24°)	Methyl hexyl ketone Methyl-m-hydroxybenzoate	(93 3) 88 4	728 ( 581)	( 596) (20°)
Hexachloroethane Hexachlorohexatrione	(112 7) (145 0)	476 433	( 995) (20°)	Methyl p-hydroxybenzoate	88 7	( 583) 403	( 918) (20°)
n-Hexadecane 1.5-Hexadiene	187 63 (55 1)	8286 671	6421 (20°) ( 462) (20°)	Methyl iodide Methylmaleic acid	(57 2) 57 84	(446)	( 721)
2,3-Hexadiene n Hexaldehyde	60 9	(741)	( 102) (20 )	9-Methyl-10 methoxyanthracene Methyl-o-methoxybenzoate	158 1 95 6	( 711) ( 575)	( 665) (19°)
2,2,4,7,9,9-Hexamethyldecane	69 40 191 52	693 <sub>0</sub> 8458	6596 (20°)	Methyl-p-methoxybenzoate Methyl-α-methoxy isobutyrate	98 6 (81 9)	( 593) 620	, \=- ,
Hexamethyl disiloxane Hexamethylene glycol	118 9 84 30	7324 713		1-Methylnaphthalene	102 8	(723)	( 741) (14°)
n-Hexane Hexene	(74 6) 65 7	8654 (27 4°) ( 781)	( 565)	2-Methylnaphthalene 4-Methylnonane	102 6 121 39	( 722) ( 853)	( 743) (20°) ( 625) (20°)
Hexestrol	(165)	$61 \pm 02$	40 H (4 - 5:	5-Methyl-5-nonene 4-Methyloctane	111 6 109 63	(706)	( 618) (20°)
n-Hexyl alcohol n-Hexyl benzene	79 20 124 23 (20°)	774 ( 767)	637 (20°) ( 658) (20°)	Methylol urea	48 3	( 855) ( 493) 8734	
n-Hexyl methyl ketone n-Hexyl methyl ketoxime	91 40	7131	( 583) ( 634) (20°)	2 Methylpentane 3-Methylpentane	75 26 75 52	8734 8764	5705 (20°) 5823 (20°)
Hexylpropiolamide	102 5 <sub>8</sub> (103 7)	716 <sub>2</sub> 677		4-Methyl 2-pentanol Methyl perfluor-n-butvrate	80 4 92 5	788 ( 406)	( 641) (20°)
Hydrindene Hydroquinone	(78 5) 64 63	664 587	( 639) (16°) ( 797) (20°)	Methyl phenylacetate	92 73	(618)	( 645) (16°)
Hydroxyazobenzene p-Hydroxybenzaldehyde	(99 7) 66 8	503	( 618) (130°)	Methyl phenylpropiolate 2-Methylpropene	95 6 44 4	597 (791)	
4-Hydroxy-2-butanone	485	( 547) 55	( 573) (14°)	Methyl propionate	(55 0)	6240	( 571) (20°)

Compound	$-x_{\rm M} \times 10^6$	$-\chi \times 10^6$	-K × 10 <sup>6</sup>	Compound	$-x_{\rm M} \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Methyl n-propyl ketone	57 41	6661	( 541) (15°)	Pentachloroethane	(99 1)	490	( 819) (25°)
Methyl-iso-propyl ketone  1 Methylpyrrole	58 45 58 56	679 <sub>0</sub> 722 (20°)	( 545) (20°) ( 664) (10°)	Pentachlorohexadione 2 3 Pentadiene	(129 5) 49 1	452 (721)	( 501) (20°)
2-Methylpyrrole	60 10	741 (20°)	(700)	n-Pentane	63 05	8739	5472 (20°)
Methyl salicylate Methyl silicone	86 30 (172 7)	567 730	668 (20°)	2 4 Pentanediol Perfluoroacetic acid	70 4 43 3	677 ( 380)	
a-Methyl styrene	(80 1)	678	( 620) (20°)	Perfluoro n-butyric acid	81 0	(378)	
2 Methylthiazole	59 56 66 35	601 (20°) 676 (20°)	( 689) (20°)	Perfluorobutyric anhydride Perfluorocyclooctane oxide	149 4 157 6	(387)	
2-Methylthiophene Methyl trichloroacetate	84 2	(475)	( 707) (19°)	Perfluoropropionic acid	61 0	(372)	ł
N-Methyl urea	44 6 55 0	(602)	(725) (631)	Perhydroanthracene Perylene	146 01 166 8	7592	7178 (20°)
Morpholine Myleran	169 7	( 631) 69	( 834) (4°)	Phenanthrene	(127 9)	662 718	( 763) (100°)
Myristic acid	176 0	(771)	( 661) (60°)	Phenanthrenequinone	104 5	502	(698)
Naphthalaidehydic acid Naphthalene	117 6 (91 9)	( 588) 717	( 821) (20°)	Phenanthrenonitrile o-Phenetidine	139 0 (101 7)	( 685) 741 (25°)	
Naphthalene picrate	185 9	(523)		p-Phenetidine	(96.8)	706 (25°)	( 749) (15°)
2-Naphthalenesulfonylamine 2-Naphthalenesulfonyl chloride	127 6 121 91	( 616) ( 538)	Į	Phenetole Phenol	(84 5) 60 21	692 (640)	( 689) (20°) ( 675) (45°)
neso-Naphthodianthrene	214 6	612		Phenothiazine	114 8	(576)	
neso-Naphthodianthrone I-Naphthol	221 8 98 2	583 681	( 834) (4°)	Phenylacetaldehyde Phenyl acetate	72 01 82 04	599 <sub>4</sub> (603)	( 614) (20°) ( 647) (25°)
•	97 0	673	( 819) (4°)	Phenylacetic acid	82 72	( 608)	(657) (80°)
2-Naphthol x Naphthonitrile	98 25 103 3	( 682) ( 674)	( 829) (4°) ( 753) (5°)	Phenylacetylene 1-Phenylazo-2 naphthol	72 01 137 6	(705)	( 655) (20°)
3-Naphthonitrile	101 0	(659)	(721) (60°)	2-Phenylbensofuran	130 5	(554) (672)	
x-Naphthoquinone	73 5	(465)	(661)	1 Phenyl 4-benzoyl 1,3 butadiene	(140 3)	599	
3-Naphthoquinone N-1-Naphthylacetamide	67 9 117 8	(429) (636)	l	Phenylbutadiene 4 Phenyl 1-butene	(85 7) 93 49	658 (7077)	( 6239) (20°)
N-2-Naphthylacetamide	117 8	(636)	757 (548)	Phenylbutyl acetate	134 5	653	` ==, \== ,
I-Naphthylamine 2-Naphthylamine	98 8 98 00	690 ( 684)	757 (54°) ( 726) (98°)	Phenyl n-butyrate Phenyl iso-cyanate	105 46 (72 7)	( 643) 610	( 699) (20°)
I-Naphthylamine hydrochloride	(127 6)	710	] ` ' ' ' '	o Phenylenediamine	71 98	6662	,
Vicotine ⊢Vitroaniline	113 328 66 47	( 699) ( 481)	( 705) (20°) ( 694) (15°)	m Phenylenediamine p Phenylenedian ine	70 53 70 28	6529 6503	( 723) (58°)
n-∖itroaniline	70 09	(507)	(725) (20°)	Phenyl ether	(108 1)	635	( 681) (20°)
- Nitroaniline	66 43	(481)	( 691) (14°)	Phenylethyl sulfide	(94.4)	6826 (27 4°)	, , , .
-Nitrobenzaldehyde n-Nitrobenzaldehyde	68 23 68 55	4517 4538		Phenylfluoroform Phenylhydrazine	(77 3) 67 82	529 ( 627)	( 688) (23°)
-Nitrobenzaldehyde	66 57	4407	( 507) (0°)	Phenylhydroxylamine	(68.2)	625	,, ,
Nitrobenzene Nitrobenzene diazo cyanide	61 80 59 22	502 ( 336)	604 (20°)	Phenyl mercaptan 1-Phenyl 2 Methylbutane	(70 8) 113 53	6425 (27 4°) ( 766)	( 693) (20°) ( 660) (20°)
-Nitrobenzoic acid	76 11	4556	(718) (4°)	Phenylmethyl sulfide	(83 2)	6695 (27 4°)	( 000) (20 )
n-Nitrobenzoic acid	80 22 78 81	4802 4718	(717) (4°) (731) (32°)	Phenylpropiolamide Phenyl propionate	(83 3) 93 79	574 (625)	(654) (25°)
o-Nitrobenzoic acid -Nitrobromobenzene	87 3	(432)	(700) (80°)	Phenylsulfone	(129 0)	591	(740) (20°)
m-Nitrobromobenzene p-Nitrobromobenzene	89 5 89 6	( 443) ( 444)	( 755) (20°) ( 859) (22°)	Phenyl thiocyanate	(81.5)	6027 (27 4°) 6365 (27 4°)	( 677) (24°) ( 719) (24°)
n-Nitro carbanilide	148 1	(576)	(859) (22)	Phenyl isothiocyanate 1-Phenyl 4,6 6-trimethylheptane	(86 0) 173 90	(796)	( 682) (20°)
Vitroethane	(35 4)	472	( 497) (20°)	N Phenyl urea	82 1	(603)	( 785)
Nitromethane I-Nitronaphthalene	21 1 98 47	3457 ( 569)	( 391) (25°) ( 696) (62°)	Phloroglucinol Phthalamide	(73 4) (91 3)	582 556	
-Nitrophenol	73 3	527 (24°)	(873) (20°)	Phthalic acid	83 61	5035	( 802) (20°)
n Nitrophenol 5-Nitrophenol	70 8 69 5	509 (25°) 500 (22°)	(756) (740)	iso Phthalic acid tere-Phthalic acid	84 64 83 51	5097 5029	(759)
-(m-Nitrophenylazo)-2-naphthol	142 0	(484)	(110)	Phthalic anhydride	67 31	(454)	(694) (4°)
-(p-Nitrophenylazo)-2-naphthol Vitrophenylfluoroform	141 7 (84 1)	( 483) 440		Phthalimide Pierie acid	(78 4) 84 38	533 (368)	(649)
-Nitropropane	45 73	5135	( 509) (20°)	Piperazine	56 8	(659)	
Vitrosobenzene V-Nitrosodiethylamine	59 1 59 3	( 552) ( 580)	( 546) (20°)	Piperidine	64 2	(754)	(650) (20°) (538) (-45°)
-Nitrosodiethylaniline	92 6	(520)	( 644) (15°)	Propane Propene	40 5 31 5	( 919) ( 749)	$(456)(-47^{\circ})$
-Nitrosodimethylaniline I-Nitrosodiphenylamine	73 3	(488)	( - , ,	Propionaldehyde	34 32	591 <sub>0</sub>	(477) (20°)
-Nitrosodiphenylamine -Nitroso-2-naphthol	110 7 83 9	( 558) ( 485)		Propionic acid Propionitrile	43 50 38 5	586 ( 699)	582 (20°) ( 547) (21°)
-Nitroso-1-naphthol	82 7	(478)		Propionylphenylacetylene	(95 1)	601	
-Nitroso-1-naphthol n-Nitrosonitrobenzene	91 8 66 0	(530) (433)		Propiophenone n-Propyl acetate	83 73 65 91	624 <sub>0</sub> 645 <sub>3</sub> (25°)	( 631) (20°) ( 569) (25°)
-Nitrosonitrobenzene	658	(433)		Iso Propyl acetate	67 04	6564	( 566) (25°)
- Nitrosophenol	50 7	(412)	( 590) (20°)	n-Propyl alcohol	45 176 (20°)	(7518)	( 6047) (20°) ( 5985) (20°)
Introsopiperidine -Nitrosotoluene	(63 4) 70 4	555 ( 581)	( 390) (20 )	so-Propyl alcohol 9-Propylanthracene	45 794 (20°) 164 0	( 7621) ( 744)	( 3963) (20 )
-Nitrotoluene	72 28	5272	( 613) (20°)	n-Propyl benzoate n-Propyl bromide	89 24	(742)	( 640) (20°)
n-Nitrotoluene -Nitrotoluene (in sol'n)	72 71 72 06	5304 5257	( 614) (20°) ( 676) (20°)	n-Propyl benzoate	105 00 (65 6)	( 640) 533	( 646) (25°) ( 721) (20°)
-Nonane	108 13	5257 8431	6057 (20°)	iso-rropyi promide	(65 1) (89 4)	529	(693) (20°)
,2-Octadiene -Octane	83 6 96 63	( 759) 8460	5949 (20°)	Propyl butyrate	(89 4) 56 10	6867 715	( 604) (15°) 633 (20°)
otanonoxime	(102 7)	717	3949 (20 )	prim-Propyl chloride iso-Propylcyclohexane	102 65	8131	6528 (20°)
Octyl alcohol	102 65	7766 (20°)	( 640) (20°)	Propylenediamine	(58 1)	784	(688) (15°)
Octyl chloride Octylcyclohexane	(114 9) 158 09	773 8051	( 676) (20°) 6578 (20°)	Propylene oxide Propyl formate	42 5 (55 0)	( 732) 6248	( 629) (0°) ( 563) (20°)
ctylene	(89 5)	798	( 576) (17°)	Propyl hexylpropiolate	(136 8)	697	
ctylene bromide -Octyl mercaptan	(150 4) (115 1)	553 7866 (27 4°)		Propyl iodide Propyl propionate (extrap )	(84 3) (77 95)	4958 (30°) 6711	( 864) (20°) ( 593) (20°)
enanthylidene chloride	(116 5)	689		Propyl sulfide	(92 1)	7787 (27 4°)	( 634) (17°)
leic acid	208 5 111 5	( 738) ( 530)	( 661) (18°)	N-Propyl urea	67 4	( 660) 845 (20°)	(740) (20°)
pianic acid valene	353 8	( 530) 888		Pseudocumene Pyramidone	(101 6) 149 0	(645)	(140) (20)
xalic acid (anh )	33 8	(375)	( 707)	Pyranthrene	266 9	709	
xalic acid xamide	60 05 (39 0)	( 4763) 443	( 787) ( 738)	Pyranthrone Pyrazine	250 3 37 6	616 ( 469)	(484) (61°)
almitic acid	198 6	(775)	(661) (62°)	Pyrene	147 9	731	(933) (0°)
araldehyde entabromophenol	(86 2) (194 0)	652 397	( 648) (20°)	Pyridine Pyrocatechol	49 21 68 76	( 622) 6248	( 611) (20°) ( 857) (15°)
entaoromopnenoi entacene	(205 4)	397 738		Pyrrole	47 6	(709)	( 688) (20°)

Compound	$-x_{\rm M} \times 10^{8}$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-x_{\rm M} \times 10^8$	$-\chi \times 10^8$	$-K \times 10^6$
Pyrrolidine	54 8	(771)	( 657) (23°)	Trianilinophosphine oxide	(201 7)	624	
Quinoline	86 0	(666)	(729) (20°)	1,2,3-Tribromopropane	(117.9)	420	(1 023) (23°)
Quinome		(355)	(468) (20°)	Tri-iso-butylamine	(156 8)	846	( 646) (25°)
	38 4		(400) (20)		73 0		
Sninouoxime	(50 4)	409	( 505) (150)	Tru hloroacetic acid (in sol n)		(44)	(723) (46°)
Resorcinol	67 26	6112	( 785) (15°)	Trichlorobenzene	(106 5)	587	
Rhamnose	99 20	605	(890) (20°)	Trichloro-tert-butyl alcoho! (in sol n)	98 01	552	
pafrol and iso-Safro	(97.5)	601	(66) (20°)	Trichloroethylene	65 8	501	( 734) (20°)
Salıcylaldehyde	64 4	(527)	(615) (20°)	Trichloronitromethane	(75 3)	458	(756) (20°)
salicylic acid	72 23	523	(755) (20°)	Triethylamine	814	(804)	(586) (20°)
oaligen in	76 9	620	( 720) (25°)	Triethyl citrate	(161 9)	586	(666) (20°)
paloÍ	(123 2)	575	678 (45°)	Triethyl phosphate	(125 3)	688	( 735) (20°)
alvarsan dihydrochloride	(246 1)	518	,	Triethylphosphine	(90.0)	762	( 610) (15°)
elenophene	66 82	510	1	Friethylphosphine oxide	(91.6)	683	( 020) (2)
so-Selenophene	110-111	84- 85		Triethyl phosphite	(104.8)	631	(611) (20°)
rans-Selenophene	70-77	53 59		Triethyl triazinetricarbonate	(164 1)	552	(011)(20)
rans-ocienophene						517	1
sorbital	107 80	592	(	Trifluorocresol	(83 8)		Ì
otearic acid	220 8	(776)	( 657) (69°)	Tri-n heptylamine	251 3	(806)	
otilbene	(120 0)	666	( 646) (125°)	Trı n hexylamıne	221 7	(823)	i
tilbestrol	(130)	62 63		Trimethylacetophenone	108 2	(667)	( 648) (16°)
tyrene	(68 2)	655	(594) (20°)	2,2 3-Trimethylbutane	88 36	8818	6086 (20°)
ouceinic acid	(57.9)	4902	( 767) (15°)	2,2 3 Trimethylpentane	99 86	8743	6261 (20°)
ouccinic anhydride	(47.5)	475	(524)	2,2,4-Trimethylpentane	98 34	8610	5958 (20°)
ou ecinimide	(47 3)	477	(674) (16°)	2,3 5-Trimethylpyrrole	82 31	754 (20°)	0000 (20 )
oulfamide	44 4	(462)	(832)	1.3 5-Trinitrobenzene	74 55	(350)	(591) (20°)
-Sulfanilamide	80 15	(465)	(802)	Triperfluorobutylamine	253 0	(377)	( 331) (20 )
			( 270) (				
Cerpineol	111 9	(725)	( 678) (room	Triphenoxyarsine	(195 2)	551	
			temp)	Triphenylarsine	(177 0)	578	
Tetrabenzylmonosilane	266 2	(678)		Triphenylarsine dihydroxide	(270 5)	795	
1,2,2-Tetrabromoethane	(123 4)	357	(1 058) (20°)	Triphenylarsine oxide	(199 1)	618	i
Cetrabiomoethylene	(114.8)	334	1	Triphenylbismuthine	(196.8)	447	(708) (20°)
Tetracene	(168 0)	736	1	Triphenylbismuthine dinitrate	$(254\ 5)$	451	1
,1,2,2-Tetrachloroethane	(89.8)	535	( 856) (20°)	Triphenylcarbinol	(175 7)	675	( 802) (20°)
etrachloroethylene	81 6	492	( 802) (15°)	Triphenylmethane	(165 6)	678	686 (100°)
Cetrahydrogumoline	(89.0)	668	(715) (4°)	Triphenylphosphine	(166.8)	636	(759)
Petraiodoethylene	(164 3)	309	( 922) (20°)	Triphenyl phosphite	(183 7)	592	(701) (18°)
etraiodoethylene		331	( 322) (20 )		(182 2)	516	(101) (10)
	(188 9)		1	Triphenylstibine			
Tetramethylketotetrahvdrofurfurane	(104 7)	736	( 000) (000)	Triphenylstibine dihydroxide	(238 5)	616	i
Cetranitromethane	43 02	2195	( 360) (20°)	N, N', N Triphenyl urea	176 5	(613)	
Cetraphenylbutadiene	228 0	(636)		Triquinoyl	(133 0)	426	}
'etraphenyldecapentaene	280 8	(643)	1	Tropolone	61	50	\
etraphenylhexatriene	246 4	(641)	į.	Tryptophan	132 0	(646)	
'etraphenyloctatetraene	264 1	(643)		Tyrosine	105 3	(581)	
etraphenylrubene	344 0	(646)		Undecane	131 84	(8435)	(6247) (20°)
etra-p-tolylmonosilane	276 4	(704)	i	Urea	33 4	(556)	(742) (20°)
etrolic acetal	(97.8)	688		Urethan	(57)	64	( 63) (21°)
etronic acid	(52 5)	525	I	iso-Valeraldehyde	(57 5)	668	(536) (17°)
					(01 0)		( 000) (11 )
hacoumerin	93 6	577	( 74.4) (4.70)	n Valeric acid	66 85	6548	(617) (20°)
hiazole	50 55	595 (20°)	(714) (17°)	iso-Valeric acid	(67 7)	663	( 621) (15°)
hiobarbituric acid	72 9	(506)		Valerylphenylacetylene	(119 0)	639	
'hiophene	57 38	682 (20°)	( 726) (20°)	Valine	74 3	(634)	Į
olane	(118 9)	667	(644) (100°)	Violanthrene	273 5	641	
oluene	66 11	7176	6179 (20°)	Violanthrone	204 8	449	ĺ
-Toluidine	76 0	710 (24°)	( 709) (20°)	iso-Violanthrone	215 9	473	
n-Toluidine	74.6	697 (25°)	(689) (20°)	Water	(13 00)	7218 (20°)	(7205) (20°)
	721	673 (25°)	( 704) (20°)	Water (value usually used as standard)	(12 97)	7218 (20°)	(719) (20°)
-Toluidine							(119)(20)
-Tolunitrile	76 87	(656)	( 666) (18°)	Xanthone	(108 1)	551	0440 (000)
-(o-Tolylazo) 2-naphthol	148 7	(567)	<b>\</b>	o-Xylene	77 78	7327	6440 (20°)
-(p-Tolylazo)-2 naphthol	157 6	(601)	1	m-Xylene	76 56	7212	6235 (20°)
		(634)	I	p-Xylene	76 78	7232	6226 (20°)
riallylacetophenone ri iso-amylamine	152 5 192	845	( 647) (25°)	Xylose	84 80	565	( 862) (20°)

### FOUR-PLACE LOGARITHMS

						OUR-F	DAGE	- 1.00	JAIL	IIIMIS									
NT.						_	•	-	0	•			Pro	por	tion	al :	Par	ts	
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10	0000	0043	0086	0128	0170	0212	2 0253	0294	0334	0374	*4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	7 0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	3 1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
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15	1761	1790	1818	1847	1875	1903	3 1931	1959	1987	2014	*3	6	8	11	14	17	<b>2</b> 0	22	25
16	1				2148	2175	2201	2227	2253	2279		5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	<b>248</b> 0	2504	2529	2	-				15			
18	l .				2648					2765	2	_				14			
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
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20					3096	1	3139				2		6	8	11	13	15	17	19
21	1				3304	3324	3345	3365	3385	3404	2		6	_		12			
22	1				3502	1	3541				2		6			12			
23	I				3692	1				3784	2	4	6	7		11			
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
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25	l				4048	]	4082				2					10			
26	1				4216	4232	4249	4265	4281	4298	2		5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	<b>567</b> 0	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	<b>2</b>	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
Ì						1					1								
40			6042			6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42		-	6253			6284	6294	6304	$\boldsymbol{6314}$	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44			6454			1	6493				1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2					7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48			6830			6857	6866	6875	6884	6893	1	2	3	4	4		6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
Ì																			
50			7007			1	7042				1	2		3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4		6	7	7
53					7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
N	0	1	<b>2</b>	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
						1								_					

<sup>\*</sup> Interpolation in this section of the table is inaccurate.

## FOUR-PLACE LOGARITHMS (Continued)

				_		DATOL .													
N	0	1	2	3	4	5	6	7	8	9	1	2				al F			9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56					7513	1				7551	1					5			7
57					7589	1				7627	_	2				5			7
58					7664			7686			li	1	2	3		4			7
59					7738	1				7774	1	1	2	3	4	4	5	6	7
05	1108	7710	1120	7731	1100	1140	1102	7700	1101	1112	1	1	2	J	•	7	J	U	'
60					7810	1		-		7846	1		2			4		6	6
61					7882					7917	1	1	2	3	4			6	6
62					7952	1				7987	1	1		3			5		6
63					8021	1				8055	1			3		4		5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67					8287	1				8319	1	1	2	3	3	4	5	5	6
68					8351	I				8382	1	1		3			4		6
69				-	8414	1				8445	1	1	_	2	3	4		5	6
70	0.451	0455	0.400	0.470	0.450	0.400	0.400	0404	0500	0500	١,		0	0				-	c
70					8476					8506	1	1				4			6
71					8537					8567	1	1	2		3			5	5
72					8597	1				8627	1	1			3		4		5
73					8657	t				8686	1	1	2		3		4	-	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77					8887	l .		8904			1	1	2	2	3	3	4	4	5
78					8943	1		8960			1	1	2	2	3	3	4	4	5
79					8998	1	-	9015			1	1	2	2	3	3	4		5
80	0021	വാഭ	9042	0047	0052	0050	ഫദാ	വരവ	0074	9079	1	1	2	2	3	3	4	4	5
81					9106	1		9122			1	1	2		3	3		4	
82	_		9149			1		9175			_			2		3		4	
1						1					1	1							
83			9201			1	-	9227			1	1	2	2	3	3		4	
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9549	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91			9600					9624			0	1	1		2	3	3	4	4
92			9647					9671			0	1	1	2	2	3	3	4	4
93					9703	l .		9717			1 -	1	1	2	2	3	3	4	4
94					9703			9763			0	1	1	2	2	3	3	4	4
ļ				0	,. 50		2,00					-	-	_	-	-	-	-	-
95					9795	1		9809				1	1	2	2	3	3	4	4
96			9832			1	-	9854			0	1	1	2	2	3	3	4	4
97	_		9877	_		1		9899			0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	1		9943			0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

### PERIODIC TABLE OF THE ELEMENTS

1a	2a	<b>3</b> b	4b	5b	6b	7b		8		1b	2b	3a	4	а.	5a	6a	7a.	0	Orbit
1 +1 H -1 1.00797			8	umber →	Sn +	-Al OA	idation St TO CHA			-								2 0 He 4.0026	к
3 +1 Li	4 +2 Be		Atomic	Weight →	118.69	-4 ← Ele	ectron Con	figuration	1			5 + B	3 6 C	+2 +4 -4	7 +1 N +2 N +3 +4 +5	8 -2 O	<b>9</b> -1	10 º Ne	
	9. <b>0122</b> 2-2											10.811 2-3	12.01 2-4		14.0067 - 1	15.9994	18.9984 2-7	20.183 2-8	K-L
	12 +2 Mg				Transition	n Elements	·				sition nents	13 + Al	3 14 Si	+2 +4 -4	15 +3 P +5 P -3	16 +4 S +6 -2	17 +1 Cl +5 +7	18 <sup>0</sup> Ar	
	24.312 2-8-2		Group 8 26.9815 28.086 30.9738 32.064 35.453 39.948											K-L-M					
19 +1 K		21 +3 Sc	22 +2 Ti +3 +4	23 +2 V +3 V +4	24 +2 Cr +3 +6	25 +2 Mn+3 Mn+4	26 +2 Fe +3	27 +2 Co +3	28 +2 Ni +3	29 +1 Cu +2	30 +2 Zn	31 + Ga	32 Ge	+2 +4	33 +3 As +5 -3	34 +4 Se +6 -2	35 +1 Br +5	36 0 Kr	
			47.90 -8-10-2	+5 50.942 -8-11-2		54.9380 -8-13-2	55.847 -8-14-2	58.9332 -8-15-2	58.71 -8-16-2	63 . 54 -8-18-1	65.37 -8-18-2	69.72 -8-18-3	72.59 -8-18	-4	74.9216 -8-18-5	78.96 -8-18-6	79.909 -8-18-7	83.80 -8-18-8	-L-M-N
37 +1 Rb			40 +4 Zr	41 +3 Nb +5	42 +6 <b>M</b> o	43 +4 Tc +6 Tc +7	44 +3 Ru	45 +3 Rh		47 +1 Ag		49 + In	50 Sn	+2 +4	51 +3 Sb +5 -3	52 +4 Te +6 -2	53 +1 I +5 +7	54 <sup>0</sup> Xe	
		88.905 -18-9-2	91.22 -18-10-2	92.906 -18-12-1	95.9 <b>4</b> -18-13-1	(99) -18-13-2	101.07 -18-15-1	102.905 -18-16-1	106.4 -18-18-0	107.870 -18-18-1	112.40 -18-18-2	114.82 -18-18-3	118.6	9 8- <b>4</b>	121.75 -18-18-5	127.60 -18-18-6		131.30 -18-18-8	-M-N-O
Cs 132.905		La	Hf	73 +5 Ta 180.948 -32-11-2	W	$Re_{+7}^{+6}$	76 +3 Os +4 190.2 -32-14-2	77 +3 Ir +4 192.2 -32-15-2	78 +2 Pt +4 195.09 -32-16-2	<b>79</b> +1 <b>Au</b> +3 196.967 -32-18-1	<b>80</b> +1 <b>Hg</b> +2 200.59 -32-18-2	81 + T1 + 204.37 -32-18-3	82 Pb 207.19 -32-1	+2 +4 9 8-4	83 +3 Bi +5 208.980 -32-18-5	Po +4	85 At (210) -32-18-7	86 0 Rn (222) -32-18-8	-N-O-P
Fr (223)		Ac +3																	-O-P-Q

PERIODIC TABLE

THE ELEMENTS

-N-O-P

-0-P-Q

*Lanthanides	Ce +4	59 +3 Pr 140.907 -20-9-2	144.24	Pm (145)	Sm <sup>+3</sup>	63 +2 Eu +3 151.96 -25-8-2		Tb	66 +3 <b>Dy</b> 162.50 -28-8-2	67 +3 Ho 164.930 -29-8-2	68 +3 Er 167.26 -30-8-2	69 +3 Tm 168.934 -31-8-2	70 +2 Yb +3 173.04 -32-8-2	71 +3 Lu 174.97 -32-9-2
**Actinides	90 +4 Th		92 +3 U +5 +6	$Np_{+5}^{+4}$	Pu +4	$Am_{+5}^{+4}$	Cm	97 +3 Bk <sup>+4</sup>	98 +3 Cf	99 Es	100 Fm	101 Md	102	103 Lw
	232.038 -19-9-2	(231) -20-9-2	238.03	(237) -22-9-2	(242) -23-9-2	(243) -24-9-2	(247) -25-9-2	(249) -26-9-2	(251) -28-8-2	(254) -29-8-2	(252) -30-8-2	(256) -31-8-2	(254) -32-8-2	

Numbers in parentheses are mass numbers of most stable isotope of that element.

### ATOMIC WEIGHTS

For the sake of completeness all known elements are included in the list. Several of those more recently discovered are represented only by the unstable isotopes. The value in parenthesis in the atomic weight column is, in each case, the mass number of the most stable isotope.\*\*

Name	Sym- bol	At.	1	ational weight	Valence	Name	Sym- bol	At. No.	atomic	ational weight	Valence
			1961	1959			50.		1961	1959	
Actinium	As	89		(227)		Neodymium	Nd	60	144.24	144.27	3
Aluminum	Al	13	26.9815	26.98	3	Neon	Ne	10	20.183	20.183	0
Americium Antimony,	Am.	95		(243)	3, 4, 5, 6	Neptunium	Np Ni	93 28	58.71	(237) 58.71	4, 5, 6 2, 3
stibium	Sъ	51	121.75	121.76	3, 5	Niobium	141	20	36.11	00.71	2,0
Argon	Ar	18	39.948	39.944	σ	(columbium)	Nb	41	92.906	92.91	3, 5
Arsenic	As	33	74.9216	74.92	3, 5	Nitrogen	N	7	14.0067	14.008	3, 5
Astatine	At	85		(210)	1, 3, 5, 7	Nobelium	No	102		(254)	
Barium	Ва	56	137.34	137.36	2	Osmium	Os	76	190.2	190.2	2, 3, 4, 8
Berkelium	Bk	97		(217)	3, 4	Oxygen	0	8	15.9994	16.000	2
Beryllium	Be Bi	4	9.0122	9.013	2	Palladium	Pd	46	106.4	106.4	2, 4, 6
Boron	B	83 5	208.980 10.811	208.99 10.82	3, 5 3	Phosphorus	P Pt	15 78	30.9738 195.09	30.975 195.09	3, 5 2, 4
Bromine	Br	35	79.909	79.916	1, 3, 5, 7	Plutonium	Pu	94	195.09	(244)	3, 4, 5, 6
Cadmium	Cd	48	112.40	112.41	2	Polonium	Po	84		(209)	0, 2, 0, 0
Calcium	Ca	20	40.08	40.08	2	Potassium,				(337)	
Californium	Cf	98		(251)		kalium	ĸ	19	39.102	39.100	1
Carbon	С	6	12.01115	12.011	2,4	Praseodymium	Pr	59	140.907	140.92	3
Cerium	Ce	58	140.12	140.13	3, 4	Promethium	Pm	61		(145)	3
Cesium	Cs	55	132.905	132.91	1	Protactinium	Pa	91		(231)	
Chromium	Cl Cr	17 24	35.453	35.457	1, 3, 5, 7	Radium	Ra	88		(226)	2
Chromium	Co	27	51.996 58.9332	52.01 58.94	2, 3, 6 2, 3	Radon Rhenium	Rn Re	86 75	186.2	(222) 186.22	0
Columbium, see		<b>"</b> "	00.0002	00.02	2,0	Rhodium	Rh	45	102.905	102.91	3
Niobium			}	1	}	Rubidium	Rb	37	85.47	85.48	1
Copper	Cu	29	63.54	63.54	1, 2	Ruthenium	Ru	44	101.07	101.1	3, 4, 6, 8
Curium	Cm	96		(247)	3	Samarium	Sm	62	150.35	150.35	2,3
Dysprosium	Dy	66	162.50	162.51	3	Scandium	Sc	21	44.956	44.96	3
Einsteinium	Es	99		(254)		Selenium	Se	34	78.96	78.96	2, 4, 6
Erbium	Er Eu	68	167.26	167.27	3	Silicon	Si	14	28.086	28.09	4
Europium	Fm	63 100	151.96	152.0 (257)	2,3	Silver, argentum. Sodium, natrium.	Ag Na	47 11	107.870 22.9898	107.873 22.991	1
Fluorine	F	9	18.9984	19.00	1	Strontium	Sr	38	87.62	87.63	2
Francium	Fr	87	20.000	(223)	ı i	Sulfur	S	16	32.064	32.066*	2, 4, 6
Gadolinium	Gd	64	157.25	157.26	3	Tantalum	Та	73	180.948	180.95	5
Gallium	Ga	31	69.72	69.72	2, 3	Technetium	Te	43		(97)	6,7
Germanium	Ge	32	72.59	72.60	4	Tellurium	Te	52	127.60	127.61	2, 4, 6
Gold, aurum	Au	79	196.967	197.0	1,3	Terbium	ТЬ	65	158.924	158.93	3
Hafnium	Hf		178.49	178.50	4	Thallium	Tl	81	204.37	204.39	1,3
Helium	He IIo	67	4.0026	4.003 164.94	0	Thorium	Th	90	232.038	(232)	4 3
Hydrogen	H	1	164.930 1.00797		3 1	Thulium Tin, stannum	Tm Sn	69 50	168.934 118.69	168.94 118.70	2,4
Indium	In	49	114.82	114.82	3	Titanium	Ti	22	47.90	47.90	3,4
Iodine	ī	53	126.9044	126.91	1, 3, 5, 7	Tungsten			21.00	1	0, -
Iridium	Ir	77	192.2	192.2	3,4	(wolfram)	W	74	183.85	183.86	6
Iron, ferrum	Fe	26	55.847	55.85	2,3	Uranium	U	92	238.03	238.07	4,6
Krypton	Kr	36	83.80	83.80	0	Vanadium	v	23	50.942	50.95	3, 5
Lanthanum	La		138.91	138.92	3	Xenon	Хe		131.30	131.30	0
Lead, plumbum	Pb		207.19	207.21	2,4	Ytterbium	Yb	70	173.04	173.04	2, 3
Lithium	Li	3	6.939	6.940	1	Yttrium	Y .	39	88.905	88.91	3
Lutetium Magnesium	Lu Mg	71 12	174.97 24.312	174.99 24.32	3 2	ZineZirconium	Zn Zr	30 40	65.37 91.22	65.38 91.22	2 4
Manganese	Mn	25	54.9380	1	2, 3, 4, 6, 7	Tancomum	21°	7.0	01.44	01.22	_ T
Mendelevium	Md	101	32.3000	(256)	-, 0, 2, 0, 1	l			\		<del></del>
Mercury,				(		* Because of na					
hydrargyrum	Hg	80	200.59	200.61	1, 2	of the isotopes of a range of $\pm 0.003$		ne at	omic weigh	it of this e	iement nas
Molyhdenum	Mo	49	05 04	95 95	348	a range of ± 0.000					

a range of ±0.003.

\*\* The 1959 atomic weights are based on O = 16.000

Molybdenum...

Mo

42

95.94

95.95

whereas those of 1961 are based on the isotope C12.